Engineering Library

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The Engineer

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PUBLIC NOTICES

The Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1 invites TENDERS for :—
3000 LAMINATED SPRINGS FOR ROLLING STOCK.
Tenders due on the 3rd February, 1928.
Forms of Tender obtainable from the above at a fee of 5s. per set, which will not be returned. 7535

Air Ministry. DIRECTORATE OF SCIENTIFIC RESEARCH.
A JUNIOR SCIENTIFIC OFFICER is REQUIRED for the Air Ministry Scientific Research Staff, primarily for duty in the Engine Research Department at the Royal Aircraft Establishment, South Farnborough.
Candidates should have an Honours Degree in Engineering and preferably have had some experience in engineering works, including experience of testing. Candidates must be medically fit for flying duties and be willing to fly as observer.
Salary £175 per annum, rising by annual increments of £15 to £235, plus Civil Service bonus, giving a present total starting remuneration of £266 per annum. The appointment will be under the Federated Superannuation System for Universities; Government contribution 10 per cent. of salary, individual contribution 5 per cent.
Preference given, other things being equal, to ex-Service men.
Application should be made on a form to be obtained from the CHIEF SUPERINTENDENT, Royal Aircraft Establishment, South Farnborough, Hants, to whom it should be returned, quoting reference No. A. 286, not later than 11th February, 1928. 7504

Assistant Engineers (5) REQUIRED by the GOVERNMENT of NIGERIA for the PUBLIC WORKS DEPARTMENT for two tours of not less than 12 nor more than 18 months' service in the first instance. Subject to satisfactory service, the officers appointed will be eligible at the expiration of three years' service for confirmation in the permanent and pensionable establishment. Salary £480, rising to £920 a year. Outfit allowance of £40 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates, preferably between 25 and 35 years of age, must have passed the examination for A.M.I.C.E. or possess a degree in civil engineering recognised by the Institution as exempting from Parts "A" and "B" of the examination. Must have had proper technical training and preferably have had not less than two years' subsequent experience on large Engineering or Municipal Works.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting M/254. 7422

Works Manager Required for the FEDERATED MALAY STATES GOVERNMENT RAILWAY for four years, with prospect of permanency (2500 men employed in workshops repairing locomotives, carriages, wagons and plant). Salary 850 dollars a month plus a strictly temporary cost-of-living allowance of 10 per cent. of salary for single men and 20 per cent. for married men. The Government rate of exchange is now 2s. 4d. to the dollar, but the purchasing power of the dollar in Malaya is at present considerably less than that of 2s. 4d. in the United Kingdom. Free passages and, if married, for wife and children also, under certain conditions. Candidates, aged 28 to 35, must have served an apprenticeship or pupilage in the Locomotive Department of a British Railway or with a firm of Locomotive Builders. They should have had a sound engineering training and experience in works management, and possess a practical knowledge of the work indicated. Some electrical training would be an advantage. Candidates should be Corporate Members of the Institution of Civil Engineers or hold an Engineering Degree or Diploma recognised as granting exemption from Sections A and B of the A.M.I.C.E. examination.—Apply at once by letter, stating age, qualifications and particulars of experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, S.W. 1, quoting M/302. 7531

Re Samuel William Plumbe DECEASED.
PURSUANT TO THE TRUSTEE ACT 1925.
All persons having claims against the Estate of Samuel William Plumbe late of 68 Lower Essex-street and 75 Addison-road King's Heath both in the City of Birmingham (who died on the 7th day of September 1927 and whose will was proved by the Public Trustee the sole Executor therein named on the 21st day of December 1927 in the Birmingham District Probate Registry) are required to send particulars thereof in writing to the undersigned on or before the 16th day of March next, after which date the Executor will proceed to distribute the assets having regard only to the claims of which he shall then have had notice.
Dated this 11th day of January 1928.
THOMAS F. WALKER,
109, Colmore-row, Birmingham,
P4052 Solicitor for the said Executor.

Bengal-Nagpur Railway Company, LIMITED.
The Directors are prepared to receive TENDERS for :—
CONNECTING-RODS FOR ENGINES.
Specification and form of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, London, E.C. 2, on or after 15th January, 1928.
A fee of 10s. will be charged for each specification, which is NOT returnable.
Tenders must be submitted not later than Noon on Wednesday, 25th January, 1928.
The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right of reducing or dividing the order.
By Order of the Board,
R. C. VOLKERS,
Secretary.
13th January, 1928. 7500

Bombay, Baroda and Central India Railway Company.
The Directors are prepared to receive up to Noon on Friday, 3rd February, TENDERS for the SUPPLY of :
GIRDER BRIDGES (40ft. Spans).
Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of £1 each (which will not be returned).
The Directors do not bind themselves to accept the lowest or any Tender.
S. G. S YOUNG,
Secretary.
Offices : The White Mansion,
91, Petty France, S.W. 1,
16th January, 1928. 7492

PUBLIC NOTICES

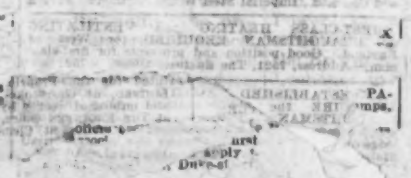
Borough of Swindon. ELECTRICITY DEPARTMENT.
The Corporation of Swindon invite TENDERS for the SUPPLY, DELIVERY, and ERECTION of TELPHER COAL CONVEYING PLANT, &c., for the new Generating Station at Moredon, near Swindon.
Specifications and forms of Tender may be obtained from Messrs. Preece, Cardew and Rider, 8, Queen Anne's-gate, Westminster, S.W. 1, on payment of a deposit of £2 2s., which will be refunded on receipt of a bona fide Tender within the prescribed time.
Sealed Tenders, endorsed "Tender for Coal Handling Plant," must be delivered to me at my office not later than 10 a.m. on Saturday, the 11th February, 1928.
The lowest or any Tender will not necessarily be accepted. The Corporation will not consider any Tender which is not in accordance with the specification.
[illegible] HILTON,
Town Clerk.
Town Hall, Swindon,
18th January, 1928. 7490

Sunderland and South Shields WATER COMPANY.
FOR SALE.
65 K.V.A. GENERATING SET.
Sulzer 85 B.H.P. Diesel Engine; Oerlikon Generator, 3-phase, 440 v., 40 cycles. Complete in every respect with all usual spare parts. New and practically unused.
TWO CENTRIFUGAL PUMPING SETS.
Rating 1500 g.p.m., 140ft. Oerlikon 100 B.H.P. Motors, 3-phase, 440 v., 40 cycles; Sulzer Single-stage Pumps.
TWO CABLE WINCHES AND CABLES.
Winches by Siemens Bros., driven by [illegible] Motors, 3-phase, 440 v., 40 cycles. Drums will take 550ft. of cable outside dia. 21in.
Two Lengths, about 260ft. and 240ft., of Special Armoured Cable, by Siemens Bros. Three-core, transmit 400 H.P. at 3000 volts.
STEEL PIPING.
About 780 Feet of 8in. Steel Piping, by Stewarts and Lloyds, in lengths of about 18ft., with loose flange joints. Test pressure 600 lb.
Above may be inspected at any time on application and offers sent to
ALFRED B. E. BLACKBURN, M. Inst. C.E.,
29, John-street, Sunderland.

PUBLIC NOTICES

Corporation of Doncaster. ELECTRICITY DEPARTMENT.
TENDERS are INVITED for the PURCHASE of the following superseded PLANT :—
ONE 670-kW TURBO-GENERATOR. Turbine, Willans and Robinson; steam pressure, 200 lb. per square inch; coupled to two Siemens direct-current generators, each of 335 kW capacity, volts 450/480 shunt, 520/550 compound, and complete with condensing plant and auxiliaries.
THREE BABCOCK and WILCOX WATER-TUBE BOILERS, evaporative capacity each 11,000 lb., working pressure 200 lb. per square inch, complete with superheaters, stokers, and all mountings.
The whole of the plant is in first-class condition and may be inspected upon application to the undersigned, from whom any further particulars can be obtained.
S. R. WINDLE,
Borough Electrical Engineer.
Electricity Offices,
Grey Friars-road, Doncaster. 7485

DIESEL ENGINES FOR SALE.
Tenders are Invited for the PURCHASE of ONE 4-CYLINDER, AIR INJECTION, FOUR-CYCLE, SULZER DIESEL ENGINE, direct coupled to 200-volt D.C. dynamo, 140 r.p.m.
Also ONE 3-CYLINDER as above.
These are giving [illegible] 400 and 300 kW respectively, and may be seen running in London by appointment. They are being removed to make room for larger sets, and will be shut down on 1st March. They must be cleared by 1st April.
Apply to the CHIEF ENGINEER, The Charing Cross Electricity Supply Co., [illegible]0, Strand-lane, W.C.



PUBLIC NOTICES

Port of Bristol Authority. EXTENSION OF THE ROYAL EDWARD DOCK, AVONMOUTH.
FOUR 4-TON ELECTRIC GOODS LIFTS, SHEDS "U" AND "V."
The Port of Bristol Authority is prepared to receive TENDERS for FOUR 4-TON ELECTRIC GOODS LIFTS for Sheds "U" and "V," Eastern Arm Extension, Royal Edward Dock, Avonmouth.
On and after Wednesday, the 25th January, 1928, copies of the specification and contract drawing can be obtained from the undersigned on production of a receipt showing that a deposit of £3 has been paid. ALL CHEQUES MUST BE MADE PAYABLE to the "PORT OF BRISTOL AUTHORITY" and forwarded to the General Manager and Secretary, Port of Bristol Authority, Docks Office, 10, Queen-square, Bristol. The deposit will be returned to bona fide tenderers after the receipt of the Tender with all the prescribed documents and drawings.
Tenders must be enclosed in a sealed envelope, endorsed "Tender for Electric Lifts," addressed to the General Manager and Secretary of the Port of Bristol Authority, 10, Queen-square, Bristol, and must be delivered to him before 10 a.m. on Monday, the 13th day of February, 1928.
The Port of Bristol Authority does not bind itself to accept the lowest or any Tender.
THOMAS A. PEACE,
Chief Engineer.
Chief Engineer's Office,
Avonmouth Docks, Bristol.
20th January, 1928. 7510

South Indian Railway Company, LIMITED.
The Directors are prepared to receive TENDERS for the SUPPLY of :—
1. ANTI-CORROSIVE PAINT.
2. CANVAS.
3. MOIST WHITE LEAD.
4. SHEET AND PLATE GLASS, &c.
5. BRUSHES.
6. SCREWS AND NAILS, &c.
7. LAMP FITTINGS AND GLASS.
Specification and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.
Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Anti-corrosive Paint," or as the case may be, must be left with the undersigned not later than Twelve Noon on Friday, the 3rd February, 1928.
The Directors do not bind themselves to accept the lowest or any Tender.
A charge, which will not be returned, will be made of 10s. for each copy of the Specification No. 1, and 5s. for each copy of the Specifications Nos. 2 to 7.
Copies of the drawings may be obtained from the offices of the Company's Consulting Engineers, Messrs. Robert White and Partners, 3, Victoria-street, Westminster, S.W. 1.
A. MUIRHEAD,
Managing Director.
91, Petty France, Westminster, S.W. 1,
20th January, 1928. 7533

FOR SALE.
WORKSHOPS IN SOUTHERN INDIA.
The South Indian Railway having constructed new Locomotive and Carriage Workshops at Trichinopoly, offer their WORKSHOPS at Negapatam FOR SALE as a GOING CONCERN.
Negapatam is a port on the east coast, about 200 miles south of Madras.
The Workshops cover an area of about 20 acres and are provided with sidings from the railway and connected by sidings with the port, at which the Company land their coal and timber.
The Shops are served by a Steam Generating Electric Power-house, equipped with Three Babcock and Wilcox Boilers and Three Bellis and Morcom 236 H.P. Engines direct coupled to Compound-wound Dynamos of Siemens manufacture, 640 amps., 250 volts D.C., with Switchboards, Spares, &c., complete.
There is a large range of permanent brick buildings suitable for a factory, with offices, stores buildings, also a number of iron sheds, &c.
The shops are equipped with wells and tanks and a service of water pipes.
Included in the sale, if desired, are about 500 D.C. motors of 5 to 50 B.H.P., and lathes and drilling machines, planing, slotting, screwing and woodworking machinery, steam hammer, saws, &c., a foundry with 2 cupolas with a pug mill.
The shops are equipped with travelling overhead cranes, stationary jib cranes and portable steam cranes.
Five thousand men skilled in all branches of locomotive engineering and carriage and wagon building have been employed in these shops and a certain amount of this labour would be available.
The works are for sale as a whole, but offers for part or parts of the works or plant will be considered.
Full particulars with a plan of the shops and site will be supplied on application to the AGENT, South Indian Railway, Trichinopoly, Madras Presidency, Southern India.
P. ROTHERA,
Agent,
7488 South Indian Railway Company.

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PUBLIC NOTICES

City of Bradford.

WATERWORKS DEPARTMENT.

APPLICATIONS are INVITED by the Water Committee of the Bradford City Council for the APPOINTMENT of DEPUTY WATERWORKS ENGINEER.

Applicants must be Members of the Institution of Civil Engineers and must have had experience in the designing and constructing of reservoir embankments and in the administrating and management of a waterworks undertaking.

The salary attached to the post will be £1000 per annum.

The successful candidate will be required to devote his whole time to the duties of the office and to reside within the City.

The appointment will be subject to the provisions of the Local Government and other Officers Superannuation Act, 1922, and the successful applicant will be required to pass a medical examination.

Applications, stating age and the date on which the duties can be commenced, accompanied by copies of three recent testimonials (which will not be returned), and endorsed "Deputy Waterworks Engineer," must be delivered to me not later than 10 a.m. on Saturday, 3rd March next.

Canvassing members of the Council, either directly or indirectly, will be a disqualification.

N. L. FLEMING,
Town Clerk.

Town Hall, Bradford, 10th January, 1928. 7470

Mersey Docks and Harbour

BOARD.
ENGINEER-IN-CHIEF.

The Mersey Docks and Harbour Board invite APPLICATIONS for the POSITION of ENGINEER-IN-CHIEF to the Board, which will be vacant at the end of June.

Candidates, who should be under 50 years of age, must be Members of the Institution of Civil Engineers and have had good experience in Dock and Harbour Construction and Maintenance and also in Estuary and River Training Works.

Applications, stating salary required, age, qualifications and experience, accompanied by copies of not more than three recent testimonials, to be sent to the undersigned not later than March 31st, 1928.

L. A. P. WARNER,
General Manager and Secretary.

Dock Office, Liverpool,
January 9th, 1928. 7454

Surrey County Council.

HIGHWAYS AND BRIDGES DEPARTMENT.
APPOINTMENT OF ASSISTANT ENGINEER.

APPLICATIONS are INVITED for the APPOINTMENT of ASSISTANT ENGINEER, to act under the general direction and control of the County Surveyor.

Salary £500, rising by annual increments of £20 to £600 per annum.

Applicants must have a thorough knowledge of and experience in the modern construction and maintenance of Roads and Bridges and of general highway administration, and be capable of managing and controlling all works in connection therewith.

Candidates must not be more than 40 years of age, and preference will be given to candidates who are Associate Members of the Institution of Civil Engineers or Members of the Institution of Municipal and County Engineers.

The appointment is subject to the provisions of the Local Government and other Officers Superannuation Act, 1922, and the successful candidate will be required to pass a medical examination and to contribute 5 per cent. of salary to the Superannuation Fund.

Canvassing, directly or indirectly, will disqualify.

Forms of application may be obtained from the undersigned, to whom applications on such forms, accompanied by copies of not more than three recent testimonials, must be delivered in sealed envelopes, endorsed "Assistant Engineer," by the 25th January, 1928.

DUDLEY AUKLAND,
Clerk of the Council.

County Hall, Kingston-on-Thames,
10th January, 1928. 7458

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED, Capable ENGINEER, Holding Board of Trade First Class Certificate, experienced in design and running Water-tube Marine Boilers, Oil Fuel Gear, &c.—Address, stating wages, age, and experience, 7505, The Engineer Office. 7505 A

WANTED, CHIEF ENGINEER for Large Paper Mill in the East. Must have had extensive general engineering experience, together with good knowledge of modern power and steam practice. Not under 35 years of age. Mill in healthy locality. Good terms to suitable applicant.—Write, "Z.A. 857," c/o Deacon's Advertising Agency, Fenchurch-avenue, E.C.3. 7490 A

WANTED, CHIEF ENGINEER for STEEL WORKS, with experience of Maintenance of Rolling Mills, Electrical Steam and Hydraulic Plant. State full particulars and salary required.—Address, "CHIEF," Wm. Porteous and Co., Advertising Agents, Glasgow. P4030 A

WANTED, ENGINEER, to Fill Position of Chief Engineer to the Amalgamated Cotton Mills Trust, Limited. Must be thoroughly experienced in every branch of Steam and Electric Power Generating Plants, Mill Gearing and General Engineering. Only highly qualified and experienced men need apply.—Applications, to be accompanied by references and qualifications and stating salary required, should be addressed to AMALGAMATED COTTON MILLS TRUST, Ltd., Yard Works, Preston. 7486 A

WANTED, Experienced COST CLERK for Engineering Firm; must be capable, quick, and accurate and submit satisfactory references.—Address, stating age, experience, and salary expected JARDINES, Chelsea-street, New Basford, Notts. 7507 A

WANTED, REFRIGERATION ENGINEER (30-35), thoroughly competent in Design, Cost and Erection of Plant for Icemaking, Cold Storage and Ice cream.—Address, 7527, The Engineer Office. 7527 A

APPLICATIONS will be Considered for the POST of MANAGER of London Office.—Write, SECRETARY, Brown, Bayley's Steel Works, Limited, Sheffield. 7498 A

CHIEF WORKS ENGINEER REQUIRED by a large Quarrying, Tar-macadam, and Asphalt Company, to Take Sole Charge and Responsibility of Principal Works and to Act in a Supervisory Capacity for the remainder of the Company Plants. Executive, organising ability, experience in handling men and mechanical knowledge essential. Foreign or colonial civil engineering experience, draughtsmanship, knowledge of designing and erecting of machinery and previous experience of producing road materials from quarries, will receive extra consideration. Good salary and excellent prospects for the right man.—Write, Box 800, Sells Advertising Offices, Fleet-street, E.C. 4 7494 A

CONTRACTORS' JUNIOR ENGINEER REQUIRED for large Waterworks Contract, Yorkshire. State age, experience, and salary required.—E. LEHANE, MACKENZIE and SHAND, Ltd., 37, Iron Gate, Derby. P4068 A

ENGINEER SALESMEN WANTED for Patented Drop-forged Conveyor Chain. Unique advantages, commission only.—Address, giving full particulars, 7538, The Engineer Office. 7538 A

ENGINEER WANTED, with About £300 Capital available, to Take Up immediately responsible SUPERINTENDENT POSITION.—Address, P4073, The Engineer Office. P4073 A

EXPERIENCED ENGINEER REQUIRED to Assist in the Management of a British Firm in India, who have Structural Steel and Bridge Workshops, Ironfoundries and Machine Shops. Qualifications required:—A good general practical and theoretical engineering training, experience in the control of men both in office and workshops, good organiser, commercial experience in handling correspondence, preferably University Degree and A.M.I.C.E. or hold equivalent qualifications. Age 30 to 35. Good salary and prospects for a suitable man.—Address, giving full particulars, P4066, The Engineer Office. P4066 A

SITUATIONS OPEN (continued)

AN EXCELLENT INSIDE ADVERTISING POST VACANT

FOR A MAN OF 25 TO 35.

HE Must Have a Good General Advertising Experience.

He must also have a fair knowledge of Printing Works and their various processes, and be familiar with the printer's point of view towards suppliers of machinery and material.

The post is Advertising Manager to a technical firm supplying to printers.

The work is partly technical press advertising, but mainly and particularly the preparation of postal publicity and a house magazine.

The post carries a comfortable salary.

Apply in the first instance to

MAX RITTENBERG,
Registered Practitioners in Advertising,
35, Henrietta-street, London, W.C. 2.
'Phone: Regent 5491. 7534 A

MECHANICAL ENGINEER REQUIRED (Headquarters London), having good sales experience with Turbo-electric and Air Compressing Machinery. Applications can only be considered from experienced candidates possessing a first-class general and technical education (Diploma or Degree) and a good practical experience in this branch.—Address full particulars, including age, 7530, The Engineer Office. 7530 A

ONE ASSISTANT WORKS MECHANICAL ENGINEER and ONE ASSISTANT WORKS CIVIL ENGINEER REQUIRED. Candidates should be between 25 and 30 years of age, and must have sound technical training with University Degree or Diploma of one of the principal Engineering Colleges, and not less than three years' erection experience with well-known firm. Experience with contractors an advantage.

Applications will be considered only from first-class men with the above training and experience.

Apply in first instance by letter, stating age, qualifications, experience, and salary required, to BRUNNER, MOND and CO., Ltd., Northwich, Cheshire. 7483 A

REINFORCED CONCRETE SENIOR DESIGNER REQUIRED, with specialist experience in all types of Concrete Construction.—Address, stating age, experience, and salary required, 7475, The Engineer Office. 7475 A

REPRESENTATIVE, Calling on Large Engineering Works, WANTED, different districts, high-class line, pneumatic tools; commission only; excellent prospects.—Address, giving age, experience, territory, particulars in confidence, 7537, The Engineer Office. 7537 A

REPRESENTATIVE WANTED, London and Home Counties, with live connection woodworkers, engineers' merchants, and exporters, for Emery, Glass, Garnet, Flint Cloths, Papers, and Grinding Wheels. Valuable territory granted to competent men. Full particulars area covered and references in confidence.—Address, 7478, The Engineer Office. 7478 A

REQUIRED, ENGINEER, Capable of Making Auction Sale Catalogues of Plant and Machinery. State age, experience, salary, &c.—Address, 7496, The Engineer Office. 7496 A

REQUIRED for Bolivian Railway, JUNIOR ENGINEER, with knowledge Theory and Design of Structures and preferably some outside experience. Commencing salary £350 a year and rent allowance.—Reply, giving details of education, training, experience, age, &c., with testimonials (copies only), to Box K.O., Davies, 95, Bishopsgate, E.C. 2. 7495 A

REQUIRED for Service in Kenya Colony on Three years' agreement, ARMATURE WINDER, unmarried. Fully competent rewinding 3-phase motors. Knowledge switchgear and instruments an advantage. Salary £28 per month plus 44 retained bonus, free quarters.—Address, 7522, The Engineer Office. 7522 A

REQUIRED IMMEDIATELY, Capable GENTLEMAN with thorough knowledge of German and Machine Tool Trade. Must have initiative and be able to attend to extensive correspondence.—Address in own handwriting, stating age, qualifications and references, 7356, The Engineer Office. 7356 A

WANTED, Experienced RAILWAY CARRIAGE and WAGON DRAUGHTSMEN.—Apply by letter, stating experience and salary required, THE BIRMINGHAM RAILWAY CARRIAGE and WAGON CO., Ltd., Smethwick. 7511 A

WANTED for the South of England, ONE or TWO good CHASSIS DRAUGHTSMEN, used to Commercial Vehicle Work.—Address, 7516, The Engineer Office. 7516 A

WANTED by London Firm, a Smart Young CONSTRUCTIONAL DRAUGHTSMAN, able to design Steel Buildings, &c. State age, salary and experience.—Address, 7528, The Engineer Office. 7528 A

DRAUGHTSMAN ESTIMATOR REQD., London. Must have good exp. Elevation and Conveyor Design and Erection. Aged 28/40. £312/374 p.a.—Apply, LAURIE and CO., Employment Specialists, 28, Basinghall-st., E.C. 2. No preliminary fee. 7512 A

DRAUGHTSMAN.—First-class CIVIL ENGINEERING DRAUGHTSMAN REQUIRED temporarily for Railway Engineer's Office in London; must have had some outside experience on works.

Address, stating age, experience, and salary required, 7480, The Engineer Office. 7480 A

DRAUGHTSMAN REQUIRED for Crane Designing. Must have sound knowledge and experience of Crane Work. Age 25/30.—Address, 7487, The Engineer Office. 7487 A

DRAUGHTSMAN REQUIRED, Fully Qualified in design of Water-tube Boilers and General Steam Plant Lay-out.—Apply, JOHN THOMPSON WATER TUBE BOILERS, Limited, Ettingshall, Wolverhampton. 7529 A

DRAUGHTSMEN WANTED; Good Opening to suitable men, used to design of Special Machines, Tool Equipment (specially Milling and Drilling), &c. Permanency to the right men. State age, salary, and when available, giving references.—Address, 7510, The Engineer Office. 7510 A

DRAUGHTSMAN WANTED, Who has Experience in Cams and Tools for Automatic Screw Machines. A liberal salary will be paid to suitable man.—Address, 7445, The Engineer Office. 7445 A

DRAUGHTSMAN, Young, for Design of Light, accurate Machinery. Sound practical and theoretical training essential.—TAYLOR, TAYLOR and HOBSON, Ltd., Leicester. 7499 A

EXPERIENCED DRAUGHTSMEN REQUIRED for large works on North-East Coast. Applicants must be under 35 years of age, and possess a complete training in General Mechanical Engineering, comprising first-class workshop and D.O. experience. Previous experience of chemical works plant not essential. Salary according to qualifications, with every prospect of promotion for suitable men.—Replies to be addressed to SYNTHETIC AMMONIA and NITRATES, Ltd. (associated with Imperial Chemical Industries, Ltd.), Billingham, Stockton-on-Tees. 7448 A

EXPERIENCED DRAUGHTSMAN REQUIRED, accustomed Crushing, Grinding and Cement Making Machinery.—Apply, stating age, experience, and salary required, to "W. J. C.," Edgar Allen and Co., Ltd., Imperial Steel Works, Sheffield. 7472 A

FIRST-CLASS HEATING and VENTILATING DRAUGHTSMAN REQUIRED for West of England. Good position and prospects for first-class man.—Address, 7521, The Engineer Office. 7521 A

OLD ESTABLISHED FIRM Near Manchester REQUIRE the SERVICES of a First-class DRAUGHTSMAN, thoroughly experienced in High-speed S[illegible]gine and Compressor Work; a knowledge of [illegible] Injection Oil Engines also an advantage. State [illegible] salary, and when disengaged.—Address, [illegible] Engineer Office. 7506 A

SITUATIONS OPEN (continued)

MECHANICAL and GENERAL DRAUGHTSMEN REQUIRED, to Prepare Detail and Scheme Drawings for proposed New Plant.

Candidates should be between 25 and 30 years of age, and the following training is essential:—

Sound technical training, 3 years' workshop experience with well-known firm of General Engineers, 3 years' drawing office experience.

Applications will be considered only from first-class men with the above training and experience.

Apply in the first instance by letter, stating age, qualifications, experience, and salary required, to BRUNNER, MOND and CO., Ltd., Northwich, Cheshire. 7482 A

PLANT DRAUGHTSMAN REQUIRED for Structural Engineering. Accustomed to Jig and Tool Design and Maintenance of Plant. Several years' practical experience and good knowledge of machine tools necessary. A live young man used to railway wagon or structural engineering preferred.—Write, stating full particulars of qualifications and salary required, to Box No. 722, W. S. Crawford, Ltd., 233, High Holborn, W.C. 1. 7499 A

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A Seven-Day Journal

Two Departmental Committees on Railways.

THE Ministry of Transport came into being officially in September, 1919, and following the hope expressed by Sir Eric Geddes, during the debates of that year, that 50 millions could be saved annually by, *inter alia*, electrification on a large scale, a Departmental Committee was appointed in March, 1920, to consider the question of uniformity of electrical equipment on railways, and whether any system then in force should be altered. On the latter point the Committee made an interim report on July 12th, 1920, recommending that the installation on the Brighton line should remain unaltered. In the following October the terms of reference were enlarged. The Committee made its final report on June 30th, 1921, and therein offered certain recommendations. Since then, however, so many great improvements have been made that some of the Committee's recommendations are obsolete. In view of that fact, the Ministry of Transport has now appointed a new Departmental Committee, over which Colonel Sir John Pringle is to preside, to review the earlier recommendations. In just the same way the recommendations made in 1922 by the Departmental Committee on Automatic Train Control are out of date, and so another Committee, also with Sir John as its chairman, has been appointed to consider the later developments now available therein. Particulars of these Committees will be found in our Railway Notes.

A New Naval Bomb.

ACCORDING to the naval correspondent of a London daily newspaper, the United States Navy Department is now in possession of a new type of aircraft bomb, tests of which are said to have proved conclusively the futility of battleships in warfare. The new agent of destruction is described as a "diving bomb." On falling into the water, it seems, the bomb does not explode until it has sunk to a depth of 20ft. to 30ft., and therefore it acts as a mine or depth charge against the unarmoured bottom of a ship. The first bomb of this description is stated to have been made at Frankford Arsenal, Philadelphia, seven years ago, but the design has recently been much improved. As now made, the bomb weighs 4300 lb., and has a length of 14ft. and a diameter of 2ft. It contains a charge of 2000 lb. of T.N.T., or about four times the amount of high explosive contained in the largest naval mines or torpedoes of to-day. Aeroplanes carrying one of these bombs are said to have reached a height of 8000ft. When dropped from 4000ft. against a land target, one of the bombs blew a crater in the ground measuring 65ft. across and 19ft. deep, and displacing 1046 cubic yards of earth. These figures are said to have good authority behind them. Their most striking feature is the implied weight of the shell, 2300 lb. The density of T.N.T. varies from 1·3 to 1·7, according as it is in the powder or cast form. Accordingly, 2000 lb. of the explosive should occupy from 24·6 to 19 cubic feet. If the bomb is a plain cylinder, its dimensions imply that it has a total volume of about 44 cubic feet. The net volume of the shell is therefore between 19·4 and 25 cubic feet. As it weighs 2300 lb., the specific gravity of the material of which it is constructed lies between 1·88 and 1·44. These figures preclude the possibility of the shell being made of aluminium, but they strongly suggest that the metal employed is electron, the specific gravity of which is 1·78. If the metal used is electron, it would appear that the walls of the shell are about 3in. thick.

The Late Mr. Alfred W. Baird.

IT is with deep regret that we have to record the death of Mr. Alfred W. Baird, a director of Kelvin, Bottomley and Baird, Ltd., of Glasgow, who was accidentally drowned early last week at Dundee, after attending the trials of the new motor tanker British Faith. Mr. Baird had travelled to Dundee to adjust the compasses of the new tanker and to inspect the sounding machines which were supplied by his company. After the trials had been completed, the British Faith returned to the Tay and was met by a tug at Dundee to take off the officials and passengers. While those aboard were being transferred to the tug, it was noticed that someone slipped from the accommodation ladder and fell into the water. Lifebelts were immediately thrown from the ship, but although the tug cruised in the vicinity for some time, no trace of the missing person, who afterwards was identified as being Mr. Baird, could be found. It is assumed that in the darkness Mr. Baird did not see the lifebelts, and that he was swept down stream by the receding tide. There are few men more highly esteemed in their profession than was Mr. Baird, who had a wide circle of friends among naval officers, shipowners and shipbuilders, both at home and abroad. He was born in Glasgow and received his early education at Glasgow Academy. When quite a young man he was appointed to be a personal assistant to Sir William Thomson (afterwards Lord Kelvin), with whom he worked for over fifteen years, having charge of the department in the works which were concerned with the development of Kelvin's scientific inventions and navigating instruments. At the time of his death Mr. Baird was sixty-five years of age, and he had been with his firm over forty years. He was a partner of the firm of Kelvin and James White, and was a director of the present firm, Kelvin, Bottomley and Baird, Ltd. Mr. Baird was an associate of the Institution of Naval Architects and was a recognised authority on ship compasses.

Tyne Shipping and Shipbuilding Developments.

EARLY in the week an official announcement was made to the effect that Furness, Withy and Co., Ltd., of London, had acquired the share capital of Cairns, Noble and Co., Ltd., of Newcastle-upon-Tyne, the managing owners of the Cairn Line of Steamships, Ltd. We understand, however, that the actual shares of the Cairn Line have not been acquired, and that this company, as heretofore, will continue to operate under the chairmanship of Sir William Noble. The fleet of the Cairn Line is composed of nine cargo vessels of comparatively new design, two of which—the Cairnesk and Cairnglen—are geared turbine ships fitted with the latest type of refrigerating equipment. All the vessels have a tonnage of round about 5000 gross, and they are engaged in trade between the North-East Coast, Canada, America and Hamburg. The Cairn Line will now be worked in close co-operation with the large fleet of steamers and motor vessels owned by Furness, Withy and Co., Ltd., and its allied companies. An interesting Tyne shipbuilding development concerns the transfer of the Willington Quay Yard of the Tyne Iron Shipbuilding Company, Ltd., to Sir W. G. Armstrong, Whitworth and Co., Ltd., which was concluded on Tuesday, January 17th. This shipyard was acquired by the Tyne Iron Shipbuilding Company, Ltd., in 1876, since which year over 229 vessels, of tonnages up to 8000 tons deadweight carrying capacity, have been built in it. It has three berths, and is well equipped. The yard has been closed down for about two years, but it is expected that its new owners will begin shipbuilding operations in it in four to five weeks' time.

Workman, Clark and Co., Ltd.

WITH the recent completion of work on the motor tanker Chesapeake, belonging to the Anglo-American Oil Company, Ltd.—the main propelling engines of which vessel were described in THE ENGINEER of January 6th—operations at the shipyards and engine works of Workman, Clark and Co., Ltd., at Belfast, have, for the time being at least, come to a standstill. When the Bermuda left Belfast towards the end of last year a large number of the men and staff were paid off, and the services of others who stayed on to complete the Chesapeake have now had to be dispensed with, so that only a nucleus staff remains. What the future of this famous yard, which at one time gave employment to 12,000 men, will be, it is difficult to foretell, but hopes are still held out that some means will be found to carry on its record unbroken. An interesting appointment of a member of the firm's Belfast staff is the election of Mr. Henry M. Glass, the late general manager of Workman, Clark and Co.'s shipyards, to the directorates of Swan, Hunter and Wigham Richardson, Ltd., and Barclay, Curle and Co., Ltd. It is understood that Mr. Glass will take full control of the Barclay Curle shipyards on the Clyde. Mr. Glass was connected with Workman, Clark and Co., Ltd., for many years, and was formerly chief shipyard draughtsman.

Admiralty Staff and Expenditure.

IN a report published on Monday of this week, the Select Committee on Estimates suggests that the staff of the Admiralty could be substantially reduced without impairing the efficiency of the Navy. Since 1914, the report states, the *personnel* of the Navy has decreased from 151,000 to 102,275, and the number of ships in commission and reserve from 618 to 394. In spite of these reductions, the Admiralty staff has increased in the same time from 1900 to 3026. Were it not for the fact that the Admiralty itself has set up a committee to report on the possibilities of reducing the staff, the Estimates Committee declares that it would have recommended that a Commission or Outside Committee should be appointed for that purpose. In defence of the increased staff, the Permanent Secretary to the Admiralty compiled a memorandum, the object of which is to show that the labour of running the Navy of to-day is out of all comparison greater than it was in 1914. Although the number of men has decreased by about 43,000 since 1914, the number of different grades in which they can serve has increased from 121 to 180. The Navy, although smaller, is very much more complicated. Of the reduced number of men, 22,000 represent the engine-room and stoker complements displaced mainly by the substitution of oil for coal as fuel. Since the horse-power of the Fleet to-day is actually greater than that of the Fleet in 1914, this substitution has involved increased work for the Admiralty staff. The provisions to be made against air and underwater attack, for the co-operation of aircraft with warships, for the great developments in guns, propellants, torpedoes, fire control, radio telegraphy and electrical equipment, and, finally, the task of fulfilling the conditions of the Washington Treaty, have imposed greatly increased duties on the staff dealing with material, contracts and accounts, and explain why that staff has increased by about 650. As evidence of the increased complexity of modern war vessels, the Permanent Secretary gives the post-war and pre-war costs per ton, as follows:—Battleships, £213, as compared with £129; cruisers, £217, against £112; destroyers, £275, as compared with £133; and submarines, £260, against £195.

The Thames Flood Conference.

ON Monday of this week a conference was held at the Ministry of Health between a number of Government Departments and many local authorities to review, at the instance of the Prime Minister, the present position as regards the river Thames and its liability to cause flooding, and to settle what action could be taken to prevent a recurrence of the recent disaster. The conference decided to set up a sub-committee to consider suggestions that had been made to prevent a repetition of the flooding, and to meet again when that committee had submitted its report. On behalf of the London County Council, a statement was submitted in which it was sought to show that the disaster of the morning of January 7th arose from a probably unprecedented combination of adverse circumstances which, being outside previous experience, were beyond human foresight. It was stated that until the recent flooding the record tide reached a height of 17ft. 6in. above the Datum line. That height had been reached twice before, once in 1881 and once in 1884. Only on two other occasions, the last of which was as recently as December 26th, 1927, had the tide reached a height of 17ft. 3in. On January 7th it rose a whole foot above the previous highest record. That no flooding occurred when the second highest record occurred on Boxing Day last year was held to show that the flood-prevention works for the maintenance of which the Council is responsible had been preserved in good order.

The New Omdurman Bridge.

ON the afternoon of Monday, January 16th, Sir John Maffey, the Governor-General of the Sudan, opened the new bridge over the White Nile between Khartoum and Omdurman. The bridge will provide for both vehicular and passenger traffic, and will carry a new electric tramway on a road 30ft. wide. When the volume of traffic demands it, two additional footways, each 11ft. wide, will be constructed, and will be carried on outside brackets attached to the main trusses. There are seven 244ft. spans, and a single swinging span, 304ft. in length, which is electrically operated and will allow vessels to pass the bridge. The new bridge was built under a concession granted in 1925 to the Sudan Light and Power Company, Ltd., to develop the public utility services in Khartoum and Omdurman, which project includes water, lighting and power and transport undertakings. The companies concerned in the contract were Dorman, Long and Co., Ltd., the English Electric Company, Ltd., Callendar's Cable and Construction Company, Ltd., and the Prudential Insurance Company, Ltd. The two first-named firms were represented at the opening ceremony by Sir Hugh Bell, deputy chairman of Dorman, Long and Co., Ltd., and Mr. P. J. Pybus, chairman of the English Electric Company, Ltd. Work on the bridge was begun in the autumn of 1925, and it was finished five and a-half months ahead of the contract time, in spite of the delay caused by the general strike and the coal stoppage. The cost of the undertaking was close upon £800,000.

A Large Pipe Contract.

WE learn that the Derwent Valley Water Board has awarded to the South Durham Steel and Iron Company, Ltd., West Hartlepool, through its pipe selling agents, Cochrane and Co., Ltd., Middlesbrough, a contract for the supply of over 7000 tons of 47in. diameter mild steel pipes. These pipes will be produced from material of entirely British manufacture. The pipes will be made at the new steel pipe works of the South Durham Steel and Iron Company at Stockton-on-Tees, one of the most modern plants of its kind in the world. The outstanding feature of the contract is that the pipes required will be protected against corrosion by means of a bituminous lining applied centrifugally under the "Talbot" patented lining processes. These processes are now being largely used by waterworks engineers in Great Britain and the United States for the protection of steel and cast iron mains. It is interesting to learn that the company's works are engaged at present in executing orders for steel pipes, which have been secured against the severest continental competition, for the waterworks at Buenos Aires and the Rand Water Board's new scheme at Johannesburg. The company is also undertaking work hitherto carried out largely by continental firms for hydro-electric schemes and is at present executing orders for the North Wales Power Company for the Maentwrog hydro-electric scheme and the extensive hydro-electric pipe system of the British Aluminium Company at its new works at Lochaber, in Scotland.

An American Railway Pageant.

AN interesting and spectacular event in American railway affairs during 1927 was an effective and well managed pageant organised and operated by the Baltimore and Ohio Railroad Company for a period of two weeks in celebration of the centenary of the company's charter for building a railway westward, nearly 400 miles from the Atlantic port and city of Baltimore to the city of Wheeling, on the Ohio River. This river flowing west to the Mississippi, constituted a great water route through the vast territory of the middle-west section of the United States. The special historical importance of this railway is that it was the first railway line in the country to be operated for the public carriage of passengers and goods. Its few predecessors were principally short tram lines for handling minerals for private interests. Let us see briefly what the pageant illustrated, or rather what it represented.

THE RAILWAY.

Competition as the life of trade was the initial cause of the construction of the Baltimore and Ohio Railroad. With the opening of the Erie Canal in 1825, connecting the Hudson River with the Great Lakes, and thus giving the city of New York a direct route to the interior, there was naturally a tendency for the diversion of business to this new transportation route, thus injuriously affecting Baltimore and other coast cities. At that time the city of Baltimore, with a population of 70,000, had a large trade with the interior country beyond the Allegheny Mountains, by means of wagons on good turnpike roads. For better facilities, to compete with New York, a canal was projected, but in 1826 a board of engineers reported that it was impracticable on account of the scarcity of water for the higher levels in crossing the range.

At this critical time a meeting of a few influential citizens of Baltimore was called by Mr. Philip E. Thomas and Mr. George Brown, two merchants, who were acquainted with railway developments in England. At that meeting, held at Mr. Brown's house on February 12th, 1827, a committee was appointed to consider the feasibility of a railway, and, as a result of its report, application was made for a charter to build a railway from Baltimore to a point on the Ohio River. Horses were to be used to draw coaches and wagons, and the gradients in general were not to exceed about 1 in 176. Where steeper gradients were necessary, cable inclines were to be used. However, by the time these inclines had been built, some with gradients as steep as 1 in 45, steam locomotives had been introduced, and it was found that the engines could mount them. The cable machinery, therefore, was not purchased.

On February 28th, 1827, the State of Maryland granted a charter to the "Baltimore and Ohio Railroad Company," and the company was incorporated on April 24th. In order to begin the surveys at once, the United States Government granted a request to furnish engineer officers. Later, the company selected as its chief engineer Mr. Jonathan Knight, who had been engaged in the building of public roads. The cost of the line was estimated at £4000 per mile.

With ceremony and public celebration, the first stone was laid in open ground outside the city on July 4th, 1828. Early in 1830 a double track line had been completed to Ellicotts Mills, a distance of 14 miles, and was opened to traffic on May 24th. In April, 1832, it was at the Potomac River, 70 miles, and by December, 1834, it had reached Harpers Ferry, where it crossed this river, 82 miles, while in 1853 its important branch to Washington, the capital city, was completed.

A period of commercial depression delayed work on the main line, and it was not until 1842 that it reached Cumberland, 178 miles from Baltimore and on the east slope of the Allegheny Mountains. Then came delays owing to the heavy work involved in crossing the mountains, requiring a number of tunnels, long bridges, deep cuttings and high embankments. But on January 1st, 1853, the first train entered the terminus at the river city of Wheeling, a total distance of 378 miles. Four years later, or in 1857, auxiliary lines, which had been under construction at the same time, but which were reached by ferry steamers, since there were no bridges over the Ohio River, enabled the Baltimore and Ohio Railroad to operate into Cincinnati, 590 miles, and St. Louis, 930 miles from Baltimore.

Thereafter the system spread and widened, entering Pittsburgh in 1871, Chicago—856 miles—in 1874, and Philadelphia in 1886. From this last city it secured running powers over existing lines to Jersey City, on the Hudson River, opposite New York. At present, the Baltimore and Ohio Railroad aggregates some 5600 miles of line.

THE PAGEANT.

So much for the initial history of what is now one of the important railway systems of the world. About two years ago the officers of the company decided that the one hundredth anniversary of the railway enterprise should be celebrated in some fitting and conspicuous manner. On the actual birthday, February 28th, 1927, a dinner was given at a Baltimore theatre to about a thousand guests, after which there were presented on the stage three scenes in the early history of the company. First, the meeting of a few citizens at the house of Mr. George Brown on February 12th, 1827. Second, the laying of the first stone, on July 4th, 1828. Thirdly, the introduction of the first steam locomotive in 1830.

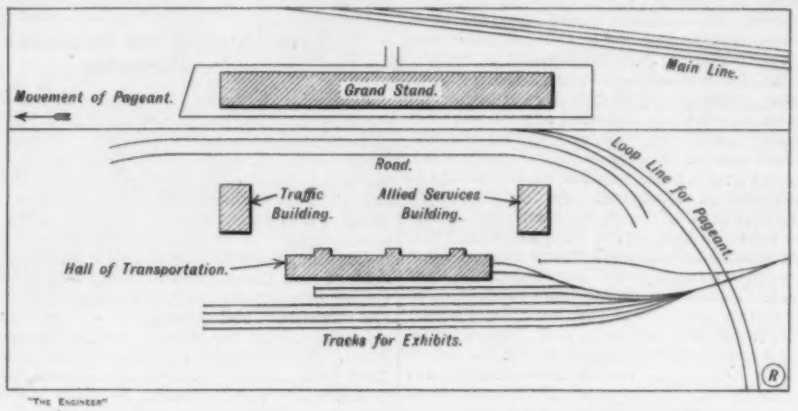


FIG. 1—PLAN OF THE PAGEANT AND EXHIBITION GROUNDS

The pageant, which was announced at that dinner, was planned to show not only the history of the Baltimore and Ohio Railroad in a period of a hundred years, but also the history of inland transportation in the United States. This display was made in the autumn.

On a tract of about 1000 acres of level ground at Halethorpe, on the main line and a few miles from Baltimore, a loop line was built about a mile in length and paralleled by a broad road or driveway. This line was for the moving part of the pageant. Within the loop was a museum or Hall of Transportation, 500ft. long and 65ft. wide. Two other buildings for auxiliary exhibits were provided, A group of sidings accommodated the modern locomotives, carriages and goods wagons, and other large exhibits that could not find place in the Hall of Transportation. Along one side of the loop track was erected a grandstand 800ft. long, with twenty-four rows of seats, accommodating in all about 12,000 persons. In addition, there were restaurants, parcel rooms, rest rooms, lavatories, and other features for the comfort and convenience of visitors, while the grounds were laid out like a park and provided with numerous seats. No charge was made for admission. A general plan of the exhibition ground is shown in Fig. 1.

The pageant moved along the railway track or the parallel roadway, passing slowly in front of the grandstand. In Fig. 2 is shown the English locomotive King George V., of the Great Western Railway, taking its part in the procession. Besides the real engines and carriages, or exact full-sized reproductions, there were "floats" or platform wagons, on which were *tableaux* representing various events, such as the laying of the first stone of the railway and the opening of the Erie Canal. Following a railway brass band,

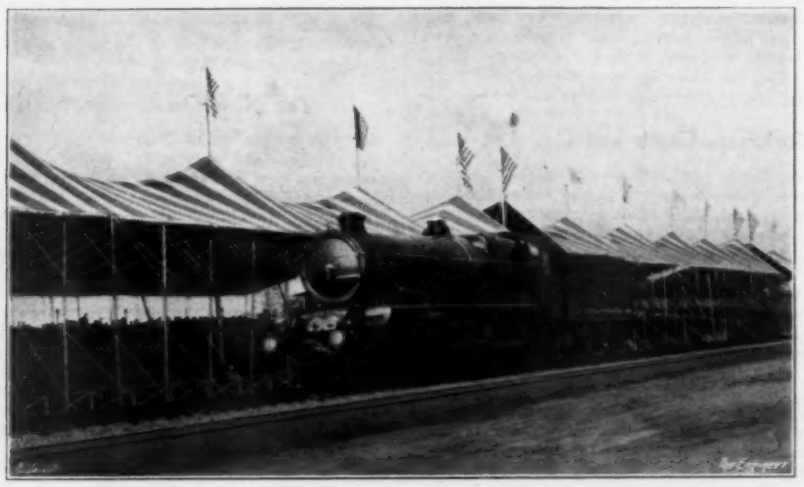


FIG. 2—THE G.W.R. EXPRESS LOCOMOTIVE "KING GEORGE V."

FIG. 3—THE "THATCHER PERKINS," 1862

the head of the pageant consisted of a group of North American Indians. Then in succession came the old-style prairie wagons of the pioneers, the pack horse, the post chaise, the stage coach and other early means of transportation. There was also one of the horse-drawn cars with which the Baltimore and Ohio Railroad was first operated.

Leading the long row of steam locomotives, old and modern, was the Tom Thumb—Fig. 7, page 76—the first locomotive of the Baltimore and Ohio, weighing only about 1 ton and put into service in 1830, after some trial runs in 1829. The rear was brought up by the Capitol, Limited, express train of 1927, with its 4–6–2 engine of 160 tons, 100-ton tender, sleeping cars, club car, dining car and observation car. Locomotives of other railways, notable for historical or modern interest, were included. Among these were De Witt Clinton, of the New York Central Railroad, 1831; the John Bull, of the Pennsylvania Railroad, 1831; the Samson, Canada's first locomotive, 1837; the John B. Jervis, of the Delaware and Hudson Railroad, 1927, with its water-tube fire-box and 400 lb. boiler pressure, some powerful Canadian engines; and the King George V., of the Great Western Railway, 1927, sent over for the pageant.

FIG. 4—THE "MEMNON," 1848

THE LOCOMOTIVES.

The collection of locomotives in real or in replica constituted the main and the most spectacular feature of the exhibition, and the pageant. There were about thirty of these, ranging in date from 1829 to 1927, and in weight from 1 ton to 205 tons, the latter exclusive of tender. Space would not permit of a description or catalogue of all of them, but a few historical or notable engines of the Baltimore and Ohio Railroad are mentioned below.

The Tom Thumb was the first steam locomotive to operate on this road. While the original intention was to operate the entire line by horses, except for certain cable inclines already mentioned, and horse traction was actually used at first, there was early talk of the possibilities of the steam locomotive. But the idea was so novel and so revolutionary that it was received with much conservative coldness. Among the stockholders was Mr. Peter Cooper, of New York, who had foreseen the probable rise in property values by the opening of the railway, and had bought land along the line. He realised also that steam traction was necessary for full development of railway transportation, and therefore brought to Baltimore a small experimental locomotive that had been designed and built by him at New York in 1829.

On August 25th, 1830, this engine with a small open carriage, as shown, made a successful trip from Baltimore to Ellicotts Mills, about 14 miles, and back. The westward journey was made in 75 minutes, and the return trip in 57 minutes. As a result of this practical demonstration, steam traction was adopted, and the railway company purchased from Mr. Cooper the right to use the vertical tubular boiler and other devices invented by him.

The Tom Thumb, which was the first American-built locomotive, consisted of a frame mounted on four 30in. wheels and carrying a vertical tubular boiler, the draught for which was furnished by a belt-driven fan. A vertical engine with a single cylinder 3½in. by 14½in. was mounted independently of the boiler and drove a spur wheel gearing with a pinion on one of the axles. This little machine weighed about 1 ton and could haul a load of 4½ tons.

Since the Tom Thumb—although a success—was an experimental machine and obviously inadequate for general railway service, the Baltimore and Ohio Railroad then offered a prize of £800 for a locomotive weighing 3½ tons and capable of hauling a train of 15 tons at 15 miles an hour on the level. In 1831 this prize was awarded to the York, built by Phineas Davis, of York, Pennsylvania. It its original form—Fig. 8, page 76—the vertical flue boiler, without tubes, had on each side a vertical inverted cylinder driving a crank arm on a cross shaft, and these arms in turn drove the two axles by means of trussed coupling rods or "walking beams." Although this engine, which weighed 3½ tons, was successful enough to win the prize in the competition, it was remodelled shortly after. The cylinders were placed side by side in front of the boiler and inclined slightly from it, with their connecting-rods driving the front axle through gearing. In this form the engine was in use for some years, hauling express trains which made the round trip of 28 miles in about an hour.

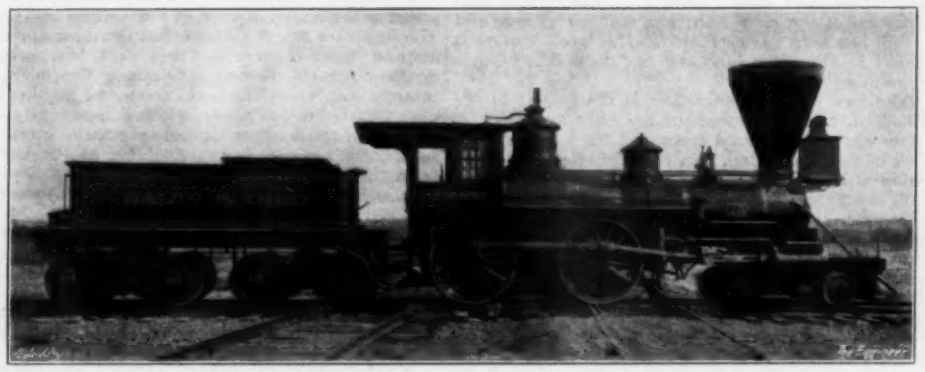


FIG. 5—THE "WILLIAM MASON," 1856

The Atlantic—Fig. 9—built in 1832, was the first of the famous "grasshopper" engines, so-called because of the long rocking levers which in operation resembled the hind legs of a grasshopper. This engine was in active service for shunting work as late as 1892, and it was run under its own steam in the pageant.

This engine, also built by Phineas Davis, weighed 6¼ tons, and could haul trains of 50 tons on runs of 40 miles. Its vertical boiler carried a working pressure of 50 lb. and had cam-operated valve gear. Two vertical cylinders seated on the underframe gave a reciprocating movement to the overhead rocking levers, the long ends of which were pivoted to attachments on top of the boiler. The shorter ends carried connecting-rods driving a shaft with spur wheel geared to a pinion on the front axle.

Passenger carriages hauled by this engine, and shown in Fig. 9, consisted of stage coach bodies slung in flexible springs on four-wheeled springless trucks.

Several engines of this type were built, some of which were considerably larger than the Atlantic. One of these—the Thomas Jefferson—weighed 15½ tons and had cylinders 12in. by 22in. Its vertical boiler, 52in. diameter and 64in. high, had a steam feed-water heater, feed pump and fan for draught. The vertical main rods drove a shaft geared to a countershaft, from the crank arms of which connecting-rods extended to the front axle, and the crank arms of the two axles were connected by coupling rods. This was one of the first engines having a cab for protection of the engine man.

In the William Galloway—shown in Fig. 10—a radical change of design is seen. This engine, built in 1837, and originally named Lafayette, was the first to have a horizontal boiler and to approximate to the later normal design of railway locomotives. It had a single pair of driving wheels at the rear and two pair of wheels under the smoke-box. The engine was designed to provide the greater power required for the heavy gradients. Its weight was about ten tons.

In Fig. 3 is shown the Thatcher Perkins, built in 1862 at the railway company's works to the design of Mr. Perkins, then master of machinery. It was the first engine of the ten-wheel or 4–6–0 type, and was intended for passenger service on the mountain division between Cumberland and Grafton, 17 miles, where there were gradients of 1 in 46. This engine had cylinders 19in. by 26in. and driving wheels 65in. in diameter, with chilled cast iron tires bolted to cast iron centres. The boiler was 48in. in diameter, and had a long fire-box 2ft. 10in. wide and 7ft. long, with a combustion chamber extending into the boiler barrel and separated from the fire-box proper by a water-circulating bridge. The fire-box had a dumping ashpan of the hopper type, and the smoke-box was fitted with wire netting in addition to the spark-catcher funnel. The boiler, carrying 130 lb. pressure, had 138 tubes, 2¼in. diameter and 12ft. 6in. long, with 1004 square feet of tube heating surface and 109 square feet of fire-box heating surface. Feed water was supplied by an injector and a feed pump. The weight of the engine was about 45 tons. In the pageant it hauled three carriages of the type used at that period.

FIG. 6—THE "ROSS WINANS," 1869

In contrast to these old engines was the express passenger engine President Washington, built in 1927. This locomotive is of the 4–6–2 class, with cylinders 27in. by 28in., driving wheels 6ft. 8in. in diameter, and weighing 160 tons, or 270 tons with the tender. It carries a boiler pressure of 230 lb. The grate area is 70½ square feet; tube heating surface, 3448 square feet; fire-box heating surface—including circulation siphon—390 square feet; superheating surface, 950 square feet. It is fitted with an automatic slotter, power reversing gear, and automatic train-control apparatus operating in connection with the signals. The tender carries 11,000 gallons of water and 17 tons of coal, and is fitted with a scoop for taking water from track tanks.

Three historically notable engines are the Memnon, 1848, shown in Fig. 4, of the 0–8–0 type, but with the two front axles arranged to swivel to some

extent, as in a bogie truck. It had inclined cylinders 17in. by 22in., and all the connecting and coupling rods were of circular section. This engine weighed 23½ tons. It had the "diamond" stack or funnel, which later was almost universal on coal-burning engines for many years; before the "extension smoke-box," which contained the spark-arresting device, as in modern engines. The William Mason—Fig. 5—was built in 1853 by Mason, who was noted for the fine mechanical work and the handsome appearance of his engines. It was one of the first of the 4–4–0 type, which became so generally used as to be known as the "American type" engine. The cylinders were 15in. by 22in., with driving wheels 5ft. in diameter, and the engine weighed 28 tons. It was one of the first engines to have the link valve gear.

The Ross Winans—shown in Fig. 6—was the first engine of another noted builder of locomotives, and had the long boiler and fire-box invented by Mr. Winans, with a large dome at the smoke-box end. It was the first of what were popularly called the "camel-back" engines, owing to the arrangement of the driver's cab on top of the boiler, to give good view and ventilation. A simple cab on the tender served to protect the fireman, but in modern engines having separate cabs, that on the tender is much more elaborate and protective. This engine had cylinders 19in. by 22in., with driving wheels 50in. in diameter. Its weight was about 37 tons.

Coming to more recent times, a notable development in passenger engines was the No. 1310, built in 1896 for the fast express trains between New York and Washington. At that time the coupling of three axles for high-speed service was generally considered undesirable, so that this fine six-coupled engine of the 4–6–0 type was a decided innovation. It had cylinders 21in. by 26in., 78in. drivers, and weighed 77 tons.

Again, in 1904, a marked step in engines for heavy goods trains was taken by the Baltimore and Ohio Railroad in introducing the first American locomotive of the "Mallet" type. This engine, the Muhlfield, was of the 0–6–6–0 type, and was used partly for regular hauling but largely for banking heavy trains over severe gradients. Since then the "Mallet" type has had a great development on American railways, for general goods service, banking, and pushing trains over the "humps" of gravity shunting yards. For general heavy goods trains the Baltimore and Ohio uses powerful engines of the 2–10–2 type, with cylinders 30in. by 32in., 64in. drivers, and a weight of 220 tons, with 172 tons on the drivers. There are also "Mallet" engines of the 2–8–8–0 type, weighing 245 tons, and having 24in. by 32in. cylinders and 58in. driving wheels.

Finally, there were two fine examples of the latest practice in American passenger engine design. The huge 4–8–2 engine, Philip E. Thomas, built in 1926, for fast service with heavy trains on the mountain gradients, has cylinders 30in. by 30in., with 74in. drivers, and a weight of 200 tons. Its total weight is 330 tons with the tender, which is carried on six-wheel bogie trucks and has a cylindrical water tank. For the Capitol, Limited, express trains between New York and Washington several large engines were built in 1927, and all named after the Presidents. The President Washington, shown at the pageant, is one of them. It is of the now familiar 4–6–2 type, with cylinders 27in. by 28in., and driving wheels 80in. in diameter. Its weight is 160 tons, or 270 tons, including the tender, which carries 11,000 gallons of water and 17½ gross tons of coal. All these engines are fitted with scoops to take water from the track tanks between the rails.

MISCELLANEOUS EXHIBITS.

On the exhibition tracks in the pageant grounds was a number of locomotives, passenger and freight cars, and specimens of old-time track or permanent way construction. In the Hall of Transportation was arranged a great variety of exhibits in the way of models, pictures, drawings and photographs of early and modern locomotives, rolling stock, bridges, and structures, together with historical documents relating to railway development.

The Allied Services Building was devoted to exhibits illustrative of the development of the electric telegraph, the telephone, the railway mail service, the Baltimore and Ohio pension and relief department. Also the railway accounting system with its modern appliances in the way of tabulating and calculating machines, pay-check and pay-roll typewriters, and way-bill writers. There were also several beautiful models of steamers, from Fulton's Clermont of 1807 to the great modern steamers of the American lakes, rivers, coasting and ocean-going service. Several foreign models included the Cunard Aquitania and the White Star Majestic.

Miscellaneous exhibits in the Traffic Building included collections of paintings and old railway tickets and time-tables. There were models also, including one of the Baltimore and Ohio coal shipping pier and its grain elevator at Baltimore. The pier is for loading coal into vessels, the coal being handled by belt conveyors having a capacity of 1500 tons an hour. These deliver to loading towers, which are equipped with devices for trimming the coal in the ship's holds. The grain elevator can load eight ships at once, at the rate of 150,000 bushels an hour, and can unload railway wagons at the rate of 60,000 bushels an hour, the wagons being put on tilting and rocking tables so that all the grain is poured out of the side doors into a great hopper.

Harbours and Waterways in 1927.

THE chief interest in the record of port development for the year 1927 is to be found in the work done in Dominion and foreign ports. The effects of the great coal strike are still felt in many home ports, and the general trade position prevents any marked advance in their development. The year was, however, notable for the completion of the Gladstone Dock project at Liverpool; while abroad several undertakings of considerable magnitude, which have been in course of construction for some years past, were brought into use. Once again the Bills, having reference to ports, deposited in the present session of Parliament indicate practically no new dock construction which it is proposed to undertake in the near future.

The United Kingdom.

Port of London.—The construction of the new Tilbury entrance lock and dock extension made good progress. The work was begun in July, 1926, and a year later the Port of London Authority placed a contract with Sir Robert McAlpine and Sons, Ltd., who are also responsible for the Tilbury contract, for the carrying out of the second part of the scheme for improving the West India and Millwall docks. This additional work includes a new entrance lock at the south West India Dock, 590ft. long and 80ft. wide. The cutting of passages between the hitherto separate West India import and export docks and the Millwall Docks had been undertaken previously, and is not yet finished. Timber storage sheds are being built at the Surrey Commercial Docks.

The trade of the Port of London during the last completed financial year showed a total tonnage of vessels of nearly 50 millions, which was a record for the port.

A minor development in the Port of London which should be noted is the conversion, by private enterprise, of the old Thames Ironworks at Canning Town to the purposes of import and export docks. Two of the old dry docks are being converted into wet docks and berths are being made along the water frontage. Railway sidings and connections with the London and North-Eastern Railway have already been laid down. This enterprise has been undertaken by S. Instone and Co., Ltd.

Work is also proceeding on the Tilbury floating landing stage and riverside station.

The Mersey and the Manchester Ship Canal.—The great event of the year at Liverpool was the opening of the Gladstone Dock by his Majesty the King on July 19th. The large new wet dock, work on the construction of which was begun by the Mersey Dock and Harbour Board in 1910, has a total water area of about 58¼ acres, including the Gladstone Dry Dock, which can be used as a wet dock. It will be remembered that this dry dock was completed in 1913, and was originally entered direct from the river. The original plans for the wet dock contemplated the retention of this arrangement, but, during the construction of the wet dock, it was decided to extend the new river wall to the northward and to enclose the dry dock within the wet dock. This modification of the original plans was, in the main, due to the greater facility of entrance and the comparative freedom from silting in the approach which are secured by the new entrance from the wet dock. At the date of the opening of the latter, the dry dock, which had been closed since 1921 during the construction of the river wall, was still out of use, and its sill has been reconstructed. This work was completed in December, and the dry dock is now once more in service.

The new river entrance lock is the largest in the kingdom, and its dimensions are only exceeded by those of the Kiel Canal locks and the new entrance lock of the Amsterdam Canal at Ymuiden, the latter being still incomplete. The sills of the Liverpool lock are 20ft. below low-water datum, and the depth of water at high water ordinary spring tides is 48ft. 4in., and at high water neap tides 42ft. 9in., thus enabling the largest ships afloat to go in and out on every tide of the year, while ships of ordinary size will be able to pass in and out of the dock at any time except for a short period at low water of spring tides, the depth over the sills at low water neap tides being 27ft. 6in. A notable feature of the lock is its alignment at a small angle to the direction of the current, and not at right angles to the river bank or nearly so, as was the old approach to the Gladstone graving dock. The same feature is noticeable in the new Antwerp and Tilbury locks. This planning avoids the necessity of large ships getting athwart the tide when entering or leaving the dock.

A new communicating lock between the Hornby Dock and the new dock places a large part of the southern docks at Liverpool in communication with the new deep lock, so that vessels proceeding to and from the older docks will be able to make use of the new entrance when necessary. The dock has been planned on the vestibule system, with ample room in the main part for turning the largest ship which can enter through the lock.

The new quayage provided in the Gladstone docks has an extent of about three miles. Most of the dock side warehouses are of three storeys, and they are equipped with roof cranes. The total cost of the new works is approximately £8,000,000.

Towards the end of the year two unfortunate marine casualties in the port of Liverpool excited considerable public interest. On November 30th the motor vessel Lockmonar went aground on the submerged revetment of the Crosby Channel and eventually broke her back. On December 13th an American oil tanker, the Seminole, grounded on the Pluckington bank opposite the Brunswick Dock. Leaks were started in several of her tanks, and some thousands of tons of naphtha and petroleum spirit were discharged into the river. Fears were entertained by the port authorities that the floating oil might be set on fire, and special and elaborate precautions were taken to minimise the risk. By a coincidence, this accident occurred while the Ministry of Transport inquiry was being held concerning the application of the Port of London Authority for approval of its proposed new by-laws authorising the transport of large bulk-oil cargoes further up the river Thames than is at present permissible.

For many years the Pluckington Bank has been a source of endless trouble to the Mersey Docks and Harbour Board owing to its continual encroachment on the fairway leading to the Brunswick Dock entrance, and as recently as September the Board authorised a considerable expenditure on the construction of two groynes or jetties, one on each side of the entrance to the dock, with the object of checking the encroachment and reducing the cost of the dredging operations in the approach channel, which, in recent years, has amounted to between £60,000 and £80,000 annually.

A scheme for the improvement of the L.M.S. Railway Company's docks at Garston, which is said to involve an expenditure of about £250,000, is under consideration.

The Manchester Ship Canal traffic returns for the year 1926 show a considerable increase, the seaborne traffic amounting to over 6¼ millions of tons, which is a record for the port. Two large five-storey transit sheds at No. 9 Dock are nearly completed.

The building of the new Bromborough Dock on the Cheshire side of the river Mersey for Messrs. Lever Bros., which has been in hand since early in 1925, is now nearing completion.

Bristol Channel and South Wales Ports.—The extension of the Royal Edward Dock at Avonmouth is to be opened by the Prince of Wales in May next. The new arm will have a depth of water of 35ft. in it and has cost the Port Authority about £1,000,000. The reinforced concrete wharves and transit sheds on the east side of the new arm form an important addition to the equipment of the port. The granary capacity will be increased by about 32,000 tons, and a grain gallery, containing six electric conveyof bands, is being constructed along the whole length or the quay.

The remodelling of the coal hoists and other mechanical appliances in the Great Western Railway Company's South Wales Docks is still being continued. The company has also deposited a Bill in Parliament authorising the abandonment of the old North Dock at Swansea, which it is proposed to fill up.

Southampton and Newhaven.—The reclamation of a portion of the site of the Southern Railway Company's dock extension at Southampton was begun during the year, as well as the dredging of the approach channel. Little was done, however, in connection with the building of the quays and wharves which form the principal part of the scheme. It will be remembered that a depth of water of 45ft. at L.W.O.S.T. is proposed in the berths in front of some of the new quays. The berth for the 60,000-ton floating dock at Southampton, moored there in April, 1924, had to be redredged for the second time since the dock was brought into use. The maintenance of the deep pit, over 60ft. below low water, which is necessary for the working of the floating dock, is evidently a costly and troublesome matter. The dredging of the channel from the sea to Southampton Docks to a depth of 35ft. at L.W.O.S.T., over a width of 1000ft., was completed during the year.

The Southern Railway Company, towards the end of the year, placed a contract for the reconstruction of the East Pier at Newhaven Harbour. The existing structure was built nearly fifty years ago and is of timber, the lower portion being sheeted and the upper part open. The new pier will be built of reinforced concrete.

North-East Coast and Humber Ports.—The new deep-water quay which the Tyne Improvement Commissioners are building in the river at the Albert Edward Dock, North Shields, at a cost of a quarter of a million pounds, will, it is expected, be partially completed and open for traffic in the coming summer. The berths at this quay will have a depth of water of 30ft. at low water of spring tides.

The Tees Commissioners approved an expenditure of over half a million pounds on the deepening and widening of the river channel from Stockton to the sea, which will take from five to six years to complete.

It is estimated that the dredging involved will amount to over 17 million cubic yards of material. The work of reclaiming an area of some 300 acres of foreshore will be undertaken concurrently with the improvement of the river channel. The depth of water aimed at is 25ft. at low water of spring tides.

The North-Eastern Railway Company is constructing an additional jetty for the discharge of oil at Salt End, Hull, and new steel gates have been provided at the Alexandra Dock in that port. The Immingham Dock gates are being repaired and partially reconstructed.

At Goole arrangements have been made to provide improved shipping facilities for coal which are intended to deal with the output of the Thorne coalfield. Electric belt conveyors are being erected.

Other Ports.—The new Workington Dock was opened by the Prince of Wales on June 30th. It is an enlargement of the old London Dock, and has been renamed after the Prince.

The Ipswich Dock Commissioners invited tenders in October for the extension of the Cliff Quay in that port.

The London, Midland and Scottish Railway Company has prepared a scheme for the development of the port facilities at Fleetwood, which was referred to by Sir Josiah Stamp at the celebration of the fiftieth anniversary of the opening of the Wyre Dock at Fleetwood on October 7th. Work was begun in December on a portion of the scheme involving an extension of the fish dock.

The Jersey States approved plans for the improvement of the harbour at St. Helier at an estimated cost of £250,000. The works are intended to provide better accommodation for the steamers of the Great Western and Southern Railways.

The first section of the Shieldhall Basins at Glasgow, which was begun in 1924, should be ready for use this year. The quay walls for the most part are founded on concrete monoliths and the depth of water will be 32ft. at L.W.O.S.T. The first pier of the basin is about half a mile long and 350ft. wide.

Fog Signals.—In the course of the summer the Trinity House brought into use at Round Island in the Scilly Isles the first of a number of wireless signals which it is proposed to establish at light stations on the coasts of England. The wireless signal is a development of wireless direction finding, which has been introduced by lighthouse authorities as an aid to navigation, particularly in time of fog. The Round Island station provides a series of transmissions at regular intervals, the period being reduced during foggy weather, to enable ships fitted with direction finders to take bearings. The transmissions are made on a wave length specially allocated for the purpose and a characteristic signal is allotted for each station. The ship's navigator, by means of a receiver, is able to take his own bearings on the transmitting station independently of the wireless operator. The Round Island signal is situated near the lighthouse and employs a single-valve transmitter of moderate power working to an ordinary open aerial. The running of the station is automatic even to the replacement of the transmitting valves in case of failure, and it is maintained in working order by the staff of the lighthouse. Similar installations are already in course of preparation for four other English stations.

British Waterways.—The ambitious proposal to construct a ship canal between the river Trent and Doncaster, which received a good deal of attention in the South Yorkshire area, seems to have been abandoned. The most interesting event in connection with the canal navigations of the kingdom which occurred during the year was the announcement of the proposed amalgamation of the Regent's Canal and Dock Company with the Grand Junction Canal Company. A Bill was deposited in Parliament to effect this, and also to authorise the acquisition of certain of the Warwick and Birmingham canals. This combination of canal undertakings will place the main canal route between the Port of London and Birmingham under one control.

European Ports and Waterways.

In our review of a year ago we chronicled the completion of the Rove tunnel, which connects the port of Marseilles with the Etang de Berre. The waterway through this tunnel was not, however, formally put into service until April last, when it was inaugurated by the President of the Republic. The completion of this work will have its effect upon the trade of Marseilles in two ways, for, in addition to the canal between Marseilles and the Etang de Berre forming a link in the inland waterway system of France, it opens up the large deep water lake for development by Marseilles as an annexe to the port. The upper section of the Rhone–Marseilles waterway, that between Arles and Port-de-Bouc, is still incomplete.

It has been decided to proceed with the construction of the Bassin du Pharo at the southern end of the Marseilles docks by building new breakwaters outside the existing breakwater of the Bassin de la Joliette, and this work, it is understood, will be put in hand at an early date. The breakwaters will not be constructed on the well-known Marseilles plan of rubble mound, with "pell-mell" block work protection on the outer face brought up to well above high water, but in accordance with a new design. The depth of water in which the breakwaters are to be built is almost everywhere 100ft. or more. The mound type, with a comparatively low solid superstructure founded above water level, when built in such a great depth of water, is more costly than the upright wall type of breakwater founded at a considerable depth on a rubble mound. The experience which Italian and French engineers have obtained during the past five years of the use of very large concrete blocks in breakwater construction, has led the Marseilles authorities to adopt this system for the new Pharo breakwaters. The blocks will weigh about 500 tons each, and four of them placed one above the other will make up the cross section of the vertical portion of the breakwater extending in height from about 50ft. below to about 3ft. above mean sea level. Above these blocks will be raised the *in situ* concrete superstructure and parapet, the top of the latter being about 19ft. above water level. The concrete blocks are practically solid. The same system of construction has been adopted for the new breakwater at Algiers and for several breakwaters in Italian harbours. The name "cyclopean" has been given to this large block construction by the Italian engineers who devised the system.

It is reported that Cherbourg has decided to spend nearly a quarter of a million pounds on the construction of a deep-water quay and maritime station for the Transatlantic traffic. Ships drawing 36ft. will be able to come alongside the piers at all states of tide.

Boulogne also is contemplating large developments in connection with Transatlantic passenger traffic. At the present time it is a port of call for nine Transatlantic steamship lines. The plans, which are now under consideration by the Ministry of Public Works, provide for the building of another breakwater on the north side of the harbour, about 2 kiloms. in length, and the extension of the present Carnot breakwater, so as to form an enclosed outer harbour, part of which will be dredged to a depth of about 43ft. at low water.

The navigation of the upper reaches of the Rhine above Strasbourg is complicated by Clause 358 of the Treaty of Versailles, by which France is authorised to build a lateral canal alongside the Rhine between Basle and Strasbourg, and to draw water from the river for the production of electric power. Before the war, the Swiss had built an inland port at Basle, in anticipation of the improvement, below that town, of the river channel, which is normally navigable only during the summer season by barges of small draught. Three distinct methods of providing an improved navigation are possible:—(*a*) Improvement of the river by regulation and deepening; (*b*) canalisation of the river; and (*c*) the construction of a lateral canal. Swiss and German opinion favoured one or other of the two first alternatives; the French pressed strongly for the last. Prolonged discussion ended in 1925 in the approval by the Central Commission of the Rhine being given both to the carrying out of river improvements by Switzerland and Germany and to the construction by France of the lateral canal which must be navigable and as free as the river itself. The first section of the canal, that between Basle and Kembs, was begun by France with the concurrence of Switzerland in 1927, and is expected to be completed, together with the first power station, in 1932. This section is probably the most important from the point of view of navigation, as it avoids the Istein rapids below Basle. The canal and its lock will accommodate Rhine barges of over 1200 tons capacity, and it is now unlikely that the alternative of river improvement will be proceeded with.

Further developments connected with the port of Antwerp are about to take place. The Belgian Government early in the year granted to the city of Antwerp rights over an area of about 7500 acres for the purpose of port extension. It is proposed also to undertake a large inland waterway scheme, which will enable barges of 1350 tons to navigate between Antwerp and Liége, a distance of 100 kiloms. The improvement of this waterway is of considerable importance to Belgium, as it will, if carried out, link up Antwerp with the canalised Meuse, which serves a large territory and has been greatly improved in the last few years from the French frontier at Givet downwards through Belgium and Holland.

The new Kruisschans Lock at Antwerp and the *bassin canal*, to which it affords entrance, were brought into use on December 20th, without any official formality. The lock is 883ft. by 114ft. internally. There is a depth of 33ft. over the sills at low water and about 46ft. at high water. Three new docks and the passage communicating with the old docks higher up the river have been completed as a first instalment of a series of docks which will eventually stretch from the new entrance to the city of Antwerp, a distance of over 5 kiloms.

The new lock at the entrance to the Amsterdam Ship Canal at Ymuiden, which will be the largest in the world, is nearly finished. The three steel rolling caissons which are to be used at the lock have been launched, and are being erected in place. Work is also in progress on the enlargement of the canal between Ymuiden and Amsterdam. The making of the Meuse–Wall Canal, which is the principal link in the improved waterway between Nijmegen and Maastricht, was completed during the year. The canal section has a bottom width of 130ft., and its depth varies from 11ft. to 13ft. The locks are exceptionally large, being 855ft. by 52½ft. internally, and can accommodate two large Rhine barges and a tug in line ahead. The other links of the new waterway are the canalised Meuse and the Juliana Canal. Five locks with weirs have been built in a length of about 67 miles of the river Meuse. Holland has expended nearly £4,000,000 on the construction and improvement of this waterway, which is now one of the finest barge navigations in Europe.

The work of regaining the submerged lands of the Zuider Zee is proceeding apace. Our readers will remember that the first section of the great sea dyke, that between the mainland of North Holland and the Island of Wieringen, was completed in 1926. Work is now in progress on the main section of the sea dyke, which extends from Wieringen to the Frisian coast, about 18¼ miles away. The areas near each end of this dyke where the navigation locks and sluices are to be constructed are being enclosed preparatory to the starting of building operations. The enclosing of the north-west polder, that lying between the island of Wieringen and Medemblik, was begun during the year.

In Italy the most interesting harbour works being carried out at present are at Naples and Genoa, where breakwaters are now being built with cyclopean blocks. The same system is also being employed for breakwaters at Palermo and Bari.

In Spain large port extensions are contemplated at Barcelona, and the Public Works Department is reported to be considering the improvement of the Port of Seville by the expenditure of over one million pounds on works of river diversion and rectification.

The first section of the new port works at the Piræus was brought into use on August 1st.

North and South America.

The development of North American ports, which has been so marked since the opening of the Panama Canal in 1914, both in the United States and Canada, appears to be as active as ever. The Port Authority of New York, which was constituted six years ago to take over the organisation and administration of the port within a radius of about 25 miles from the centre of the city, has been busily engaged in preparing schemes having as their object the relief of the congestion in the port and on the railway systems which serve the waterside frontages. The Authority, by the way, operates not only in the State of New York but in the State of New Jersey also. One of the most important means of relieving the congestion in the Hudson River and East River areas seems to lie in the development of Staten Island, and much attention is being given to this part of the harbour area. Large numbers of deep-water piers and jetties are being constructed on the water fronts of the island and the neighbouring New Jersey shores. Three large bridges connecting Staten Island with the New Jersey mainland are also being built as a part of the development scheme.

Philadephia is building a dry dock 1000ft. by 110ft. internally with a depth of 43½ft. over the sill.

The new Port of Corpus Christi on the Gulf of Mexico, not far from the Mexican border, which was brought into use at the end of 1926, has already begun to handle a considerable volume of trade mainly from the Texas oilfields. The export of cotton has also begun and, during the year, facilities on a large scale for the shipment of this commodity were brought into use. The city is not situated directly on the Gulf coast, but in a land-locked bay entered by a narrow pass 21 miles from the city. The channel, which has been dredged from the sea to the new port, is 21 miles long, and is at present 25ft. deep. This depth will be increased later. The shipping piers and basins are protected by a breakwater which is now being built across the bay.

The phenomenal growth of Los Angeles continues, and the trade handled at the port now approaches 23 million tons annually, whereas in 1919 it was under two million tons, and before the opening of the Panama Canal the port could hardly be said to have existed. The channels and some of the basins in the port are now being deepened to 35ft. at low water. During the last financial year over 3500 lineal feet of new wharves were completed and brought into use. We need hardly remind our readers that the bulk of the trade of Los Angeles is the export of oil. Millions of dollars have been expended by the large oil companies in building refineries and tank storage in the vicinity of the harbour and in providing shipping berths.

The floods in the Mississippi and its tributary rivers which began in the spring of the year were the most serious which had occurred since records of the behaviour of the "father of waters" began to be kept. For nearly fifty years the Mississippi has been under the control of a Commission, largely composed of engineer officers of the army, who have developed it and watched it with one eye on the improvement of the navigation and the other on the prevention of flood damage. They have built levees successively higher and higher as the bed of the river was gradually raised in level, until the surface of the river in many parts, even under normal conditions, was raised 20ft. to 30ft. above the level of the surrounding lands. Disaster was averted at the city of New Orleans by cutting a wide gap in the levees at Poydras, a few miles below the city, thus permitting the flood waters

to take a short course of about 5 miles to an arm of the sea instead of following the normal course of the river through the delta for a distance of over 100 miles. A special Commission appointed by the President has been investigating the problem of the future control of the Mississippi and its tributaries and the prevention of floods.

Two slides of considerable magnitude occurred during the year on the Panama Canal in the Gaillard cut, but neither caused any serious interference with the traffic of the canal. The total tonnage handled by the canal during the last financial year was over 27½ million tons, which is larger than in any preceding year. Proposals for constructing a dam across the river Chargres and thus increasing the storage capacity of water for lockage are being considered by the canal authorities.

The growth of Vancouver continues. The import and export trade in 1926 again showed a large increase over previous years, and more than a million passengers passed through the port. Additional piers, which vie with the Ballantyne Pier in dimensions and completeness of equipment, are being built. The C.P.R. Pier, which had been under construction for several years, was finished. It is of reinforced concrete, and in many ways similar to the Ballantyne Pier, but piles have been used throughout instead of cylinders, as in a part of the earlier pier. A viaduct 1000ft. long connects the pier with the shore. The grain elevator capacity has been increased to over 6½ million bushels and storage for another million bushels is nearing completion. At North Vancouver facilities for coal shipment and bunkering are being provided.

Montreal in 1926 made the biggest overseas shipment of grain of any North American port, loading 135 millions of bushels. One of the new elevators recently brought into use at this port has a maximum loading capacity of 90,000 bushels per hour; roughly, 2500 tons. Port Arthur, on Lake Superior, during the year added 2½ millions of bushels to its grain storage capacity. The total storage capacity of Port Arthur and its adjoining port—Fort William—has now reached 64 millions of bushels.

Work on the Welland Ship Canal between Lakes Erie and Ontario still continues, but it is unlikely that the waterway will be open to through traffic before 1931.

At Quebec wharves are being built with 40ft. depth of water alongside. One of these, at Wolfe's Cove, is to be 2640ft. in length. The deepening of the channel of the river St. Lawrence is making good progress. The intention is to provide a channel 35ft. deep at all states of the tide from Montreal to the sea. It is reported that 101,500,000 cubic yards of material have already been removed out of a total of over 127,000,000 to be dredged to secure the required depth throughout. The new north channel near the Ile d'Orleans, below Quebec, has been marked and buoyed and has, since June, been available at extreme low water by ships drawing 25½ft.

Nothing of great importance occurred in connection with the projects for an improved waterway between the St. Lawrence River and the Great Lakes, but the Hoover Commission, which was appointed by President Coolidge, reported early in January in favour of the St. Lawrence route against the two rival projects for an all-American canal to the Hudson and the Lake Ontario-Hudson-Welland Canal route. It is understood that further discussions took place between the Governments of Canada and the United States. The completion of the Welland Ship Canal will make it possible for large vessels to navigate from one end of the Great Lakes to the other, and such vessels will be cut off from communication with the Atlantic only by the small dimensions of the St. Lawrence lateral canals, which are not more than 14ft. in depth. It therefore seems probable that a decision to proceed with the last link of the chain which will open the Great Lakes to ocean navigation will not be delayed for many years.

The vexed question of the sea terminus of the Hudson Bay Railway was settled by the Canadian Government on the recommendation of Mr. Frederick Palmer, who, early in the year, investigated the relative merits of Port Nelson and Fort Churchill. Following Mr. Palmer's recommendation, the terminus of the railway was transferred from Port Nelson to Fort Churchill. Mr. Palmer's report was conclusive as to the superior advantages of the latter as a site for a harbour notwithstanding the large expenditure, said to amount to over a million sterling, which had already been incurred at Port Nelson. The work of transferring the plant and materials already collected at Port Nelson to the new terminus was begun in September.

In South America the most interesting work in progress is the seaward extension of the Valparaiso breakwater. This extension, in depths as much as 180ft. in places, is formed of a sand and rubble mound brought up to about 40ft. below mean sea level, the superstructure being built of concrete blocks on the sloping system.

The building of quays and jetties at Antofagasta has been carried on under the shelter of the first breakwater, the construction of which was recently completed. The construction of a second section of the breakwater and the deepening of the harbour area have now been begun.

In Brazil extensions of the port accommodation are being carried out at Santos, where quays are being built and facilities provided for oil import. It is also reported that harbour extensions are about to be begun, or are, at any rate, contemplated, at Callao, the leading port of Peru, La Guiara, and at Ilheos, on the southern coast of the Brazilian State of Bahia. Two important installations of grain-handling and storage facilities are actually being carried out by Henry Simon, Ltd., of Manchester, at Santos (Brazil) and Bahia Blanca (Argentina), the latter involving an expenditure of over one million pounds. The work includes a reinforced concrete granary of 80,000 tons capacity and grain-loading appliances, largely in the form of belt conveyors, by means of which it will be possible to load grain to ships at a maximum rate of 6000 tons per hour.

Africa.

The new port at Walvis Bay, in South-West Africa, which has taken three years to build, at a cost of about £700,000, was opened in August. A deep-water wharf, 1500ft. in length, forms a part of the work carried out. At Beira the new lighter wharves are nearly completed. The building of the deep-water wharf and the dredging work are well in hand. The present improvements were begun in April last. Two additional deep-water berths are being built at Kilindini, Mombassa.

Work on the Table Bay and Port Elizabeth breakwaters is progressing. In each case the superstructure of the breakwater is being built of sloping blocks. At Cape Town the building of a coaling jetty is also in hand, and five additional berths for large ships are being constructed alongside a widening of the south arm of the Victoria Basin. The Durban grain elevator, which has been the cause of so much trouble to the authorities of the port, has at last been completed and was brought into use in October. It has a storage capacity of 42,000 tons, which is about 12,000 tons more than the capacity of the only other South African port granary at Cape Town.

In West Africa the breakwater and harbour works at Takoradi, which were begun in 1921, reached the stage when they could be brought into use, and in March, 1928, the ceremonial opening is to be performed by Mr. J. H. Thomas, the former Colonial Secretary. The main breakwater is of the rubble mound type about 1½ miles in length.

The Portuguese Government is said to be contemplating the improvement of the harbour of Sao Paulo de Loanda, and a new port is being made by an English firm for the Belgian Government at Ango-Ango on the Congo.

In North Africa the development by the French Government of the port of Casablanca in Morocco and in Algiers continues. The Grand Mole and the transverse jetty at the former are being extended. The construction of the new Mustapha breakwater at Algiers was begun during the year. In this case the superstructure, down to a depth of 49ft. below sea level, is being built on the cyclopean block system, and a floating portal crane, of 450 tons lifting capacity, is employed for setting these huge blocks.

The East.

Towards the end of the year the Admiralty invited tenders for the construction of the new naval base at Singapore. It will be remembered that dredging operations and some preliminary work were begun in 1923. The great floating dock which is being built by Swan, Hunter and Wigham Richardson on the Tyne is nearly ready for towing to Singapore. The last of the seven sections was launched on December 10th. The construction of the dock, which will have a lifting capacity of 50,000 tons, was only commenced early in the year. Two views of the dock are given on the opposite page.

The report of the Vice-Regal Commission on the Bombay Back Bay reclamation was issued in January. The Commission recommended the partial completion of the project and suggested the substitution of dry morrum filling for the dredged material hitherto used for making up the reclaimed ground.

Important developments are contemplated at Rangoon, and a training bank is being built by the Port Commissioners across the Hastings shoal.

The new King George Docks at Calcutta, which were begun in 1920, are expected to be completed this year. In Southern India harbour works are in progress at Vizagapatam, Cochin and Tuticorin. An interesting reinforced concrete jetty is nearing completion at Madras. It is carried on piles, 25in. square, some of which are over 75ft. long. The berths alongside will have a depth of 33ft. at low water. Karachi is providing a low water depth of 34ft. in the berths at the new quays which are being built on concrete well monoliths.

Further developments are being planned for the port of Osaka, already possessing a fine harbour. The new proposals include a large increase of deep-water quay frontage. It is reported that a start will be made on the new harbour works at Haifa, Palestine, in May next.

Australasia.

There is not much to tell of new work undertaken during the year in Australian and New Zealand ports. Our record of a year ago might almost be repeated. The works at the principal ports which we then mentioned continued to progress towards completion. But, in connection with Australia, the issue in the spring of the year of Sir George Buchanan's second report to the Prime Minister of the Commonwealth on port facilities is of interest on account of its criticism of existing conditions, quite apart from the concrete proposals which it contains. We can mention one only of the many criticisms in this interesting and challenging report. Sir George points out that Sydney has 60,000ft. of quays and Melbourne 49,410ft. He considers that this provision, in comparison with ports in other parts of the world, is out of proportion to the trade handled. Bombay and Calcutta possess equipment on a scale unknown in Australia, but their combined quay space is nearly 1½ miles less than that of Melbourne. Bombay, according to Sir George, handles in a year some 269 tons of cargo per foot of quay frontage, and Calcutta 248 tons; the corresponding figures for Sydney and Melbourne are 113 tons and 99 tons. The obvious conclusion is that the Australian ports are not worked to their full capacity. We believe that the French ports used by the British Army during the war handled an import goods traffic of over 1 ton per lineal foot of quay per day on the average during the last eighteen months of the war. An average capacity figure of 300 tons per annum per foot of quay is not too much to aim at in busy and well-equipped modern ports of the first class.

New Waterworks for Durban.

THE following particulars of the recently completed Vernon Hooper dam in the Shongweni Valley, which furnishes an additional supply of water to the Borough of Durban, were received too late for inclusion in our Annual Article on Water Supply. Although water had been drawn from this new source for some time past, the formal opening of the works did not take place until December 15th last, when it was performed by Sir George Plowman, K.C.M.G., the Administrator of Natal.

Before proceeding to describe the works, it may be of interest perhaps to glance briefly at the early history of the Borough's water supplies. The original source was a well dug in St. George's-street in 1854, or a little later. It was followed by other wells, and it was not until the late 'seventies that Currie's Fountain, together with pumps, storage tanks and distribution pipes were put into service, and that some semblance of an ordered water supply system came into being. Even it, however, could not prevent the town suffering great privations during the dry season of 1878, when water had to be carted from the river Umgeni and sold for a penny a pail full.

In 1883 what was known as the Umbilo scheme was sanctioned, and it took four years to complete. Three years afterwards it fell into disrepute. Then the Umlaas scheme was adopted, and was put into operation as soon as might be. Then followed a period when all apparently went well, but in 1905 the works at Umbilo were destroyed by floods, and in 1917 the Umlaas works suffered severely from the same cause. It was then that the authorities determined that it was no longer safe to rely on the existing resources, and the late Mr. W. Ingham, M. Inst. C.E., and Mr. George A. Stewart, M. Inst. C.E., were called in as joint consultants to advise as to the best manner in which to obtain a further supply. As a result, what is known as the Shongweni (Umlaas) scheme was adopted, and it is it which has just recently been brought to completion after a constructional period of some five years. By it, the available supply to the borough has been increased from seven to seventeen million gallons per day, and the district's needs have been assured for many years to come. The undertaking embodies the following works:—(*a*) The Vernon Hooper dam across the Shongweni Valley; (*b*) a flood diversion scheme, which will be referred to later; (*c*) an aqueduct from the dam to the outskirts of Durban; (*d*) a filtration plant at Northdene; (*e*) a pipe line to convey the filtered water to (*f*) a large new service reservoir at South Ridge, Durban.

The point in the valley chosen for the dam is at the confluence of the Umlaas River, the Sterk spruit, and the Ugede stream. The reservoir which has been formed by the dam will, when it is full, contain some 2600 million gallons of water, and the water surface will extend 2¼ miles up the Umlaas, 1¼ miles up the Sterk, and half a mile up the Ugede.

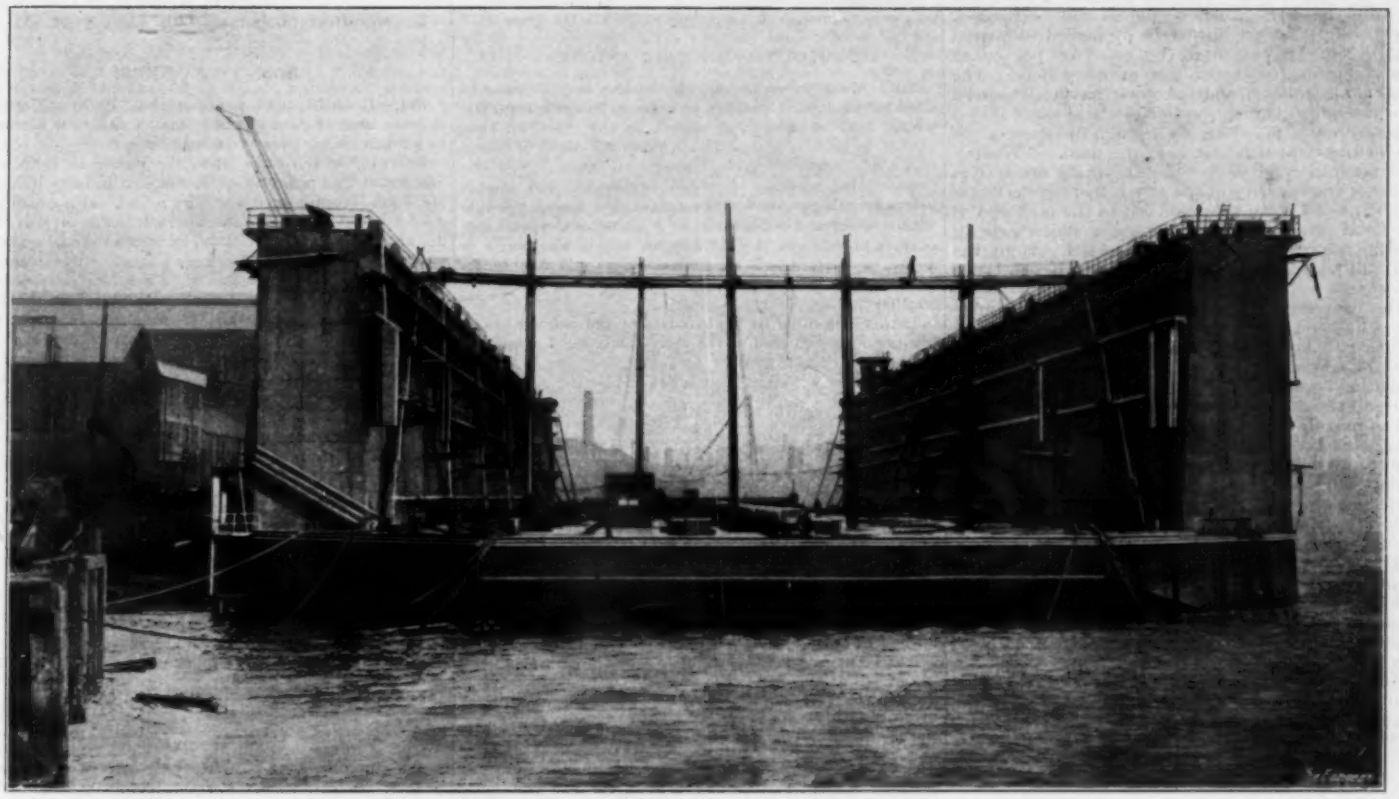
The dam, which is of mass concrete, has a maximum length at its crest of 808ft., and a maximum height of 94ft., the spillway being at 87ft. above the river bed and 500ft. long. The maximum breadth of the dam at its base is 70ft., the breadth at the top being 8ft., and its bulk is given as approaching three million cubic feet.

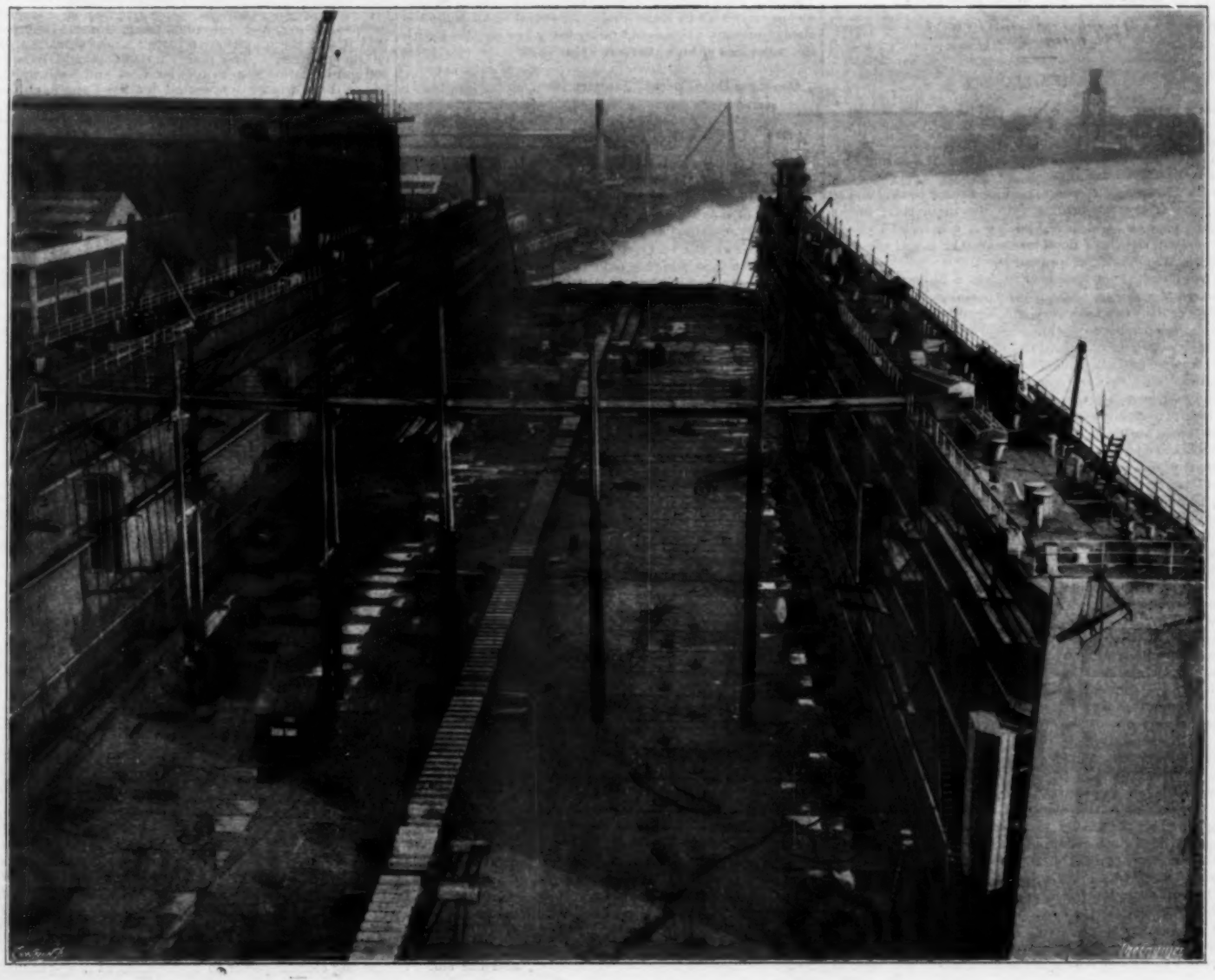
To the right of the spillway, looking downstream, is a syphonic system, which is a feature quite new in water engineering in South Africa. According to a description of the whole undertaking which appeared in a recent issue of the *Natal Advertiser*, and from which our information is obtained, this system was introduced in order to test the efficacy of increased spillway velocity in removing silt. The syphons, of which there are twelve, are automatic in their action and great care has been taken in their construction,

50,000-TON FLOATING DOCK FOR SINGAPORE

SWAN, HUNTER AND WIGHAM RICHARDSON, LTD., WALLSEND-ON-TYNE, BUILDERS

(For description see opposite page)





so that the experiment that they represent may be exhaustively tested.

In order further to cope with the silt question, the flood diversion scheme referred to above has been adopted. A diversion weir, 28ft. in height, has been thrown across the river at the upstream end of the reservoir. When the river is comparatively free from silt, the water will be allowed to flow over it into the reservoir. When, however, the river is in flood and its water heavily silt-laden, sluices will be opened, which will permit the flow to be by-passed through a canal designed to pass up to 1100 cubic feet per second —or enough to cope with any ordinary flood. The canal is a mile long, and the water having traversed it, will descend through a 40ft. vertical shaft into a larger by-wash tunnel driven through the slope of the hill on the right-hand flank of the dam. "When," says our contemporary, "the oncoming flood is in excess of the capacity of the canal, the surplus water will be passed down the river bed to the inlet end of the flood by-wash tunnel, where a sluice gate of massive proportions has been erected. Here the flow will be diverted and passed through this latter tunnel to a point downstream of the dam."

The capacity of the larger tunnel is 8000 cubic feet per second—or at the rate of some 4300 million gallons per day—which is sufficient to deal with a flood of considerable dimensions. When the flood is abating—which is the period of maximum deposition—all the flushing arrangements will be open, and will so remain until the major portion of the silt has been passed through. By these means it is confidently hoped that the efficient life of the Shongweni works will be considerably longer than that of similar works not protected in the same manner.

In order that the pre-existing Umlaas works may be properly served, it is necessary to allow some six million gallons of water per day to flow past the Vernon Hooper dam. That circumstance has been taken advantage of to install a turbo-generator which furnishes sufficient electrical energy for lighting the works and for operating pumps to provide the pressure water used for operating the various valves, &c.

Mr. Walter M. Campbell, M. Inst. C.E., M.I. Mech. E., was originally appointed Borough Water Engineer in 1919, and, on the death of Mr. Ingham, he was, in addition, made joint consultant with Mr. Stewart. It was under his direct supervision that the whole of the constructional work was carried out.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

THAMES FLOODS.

SIR,—Viewing the disastrous results of the floods in the Thames Valley, one is tempted to ask whether the present system of immovable stone or concrete weirs is responsible for and the cause of the annual flooding of a large tract of country.

It is some twenty-three years since I came to this house, which is on a creek leading into the main river above Teddington lock, and in the winter it was usual to have 8in. or 10in. depth of flood water on the lawn, which is some 3ft. above normal summer level.

When Teddington lock was rebuilt a by-pass cut was added to the sluices originally incorporated in the weir, increasing their capacity very considerably, and since that time the flood water to my knowledge never rose more than 2ft. or so above normal until the night of Friday, January 6th, when we had about 6in. depth on the lawn. This was only for a short period during the time of high tide — Teddington, which is the limit of tidal water in the river, and results in holding up the passage of flood water coming downstream until the tide has turned, when the level begins at once to drop, and at low water my boat landing is frequently 6in. to 9in. above the water level. It was so to-day.

It would therefore seem to show that the present system of immovable weirs is responsible for the flooding, because the weirs obstruct the free flow of the water and the sluice capacity is too small. It would be interesting to know what the sluice capacity of each weir is and the capacity of the river main stream adjoining. This would give some indication of how much water is held back by reason of the weir obstruction.

A local newspaper last week, although full of pictures of the floods above Molesey and other places higher up, had a paragraph stating that there had been no material flooding at Richmond. Now, Richmond is fortunate in having the only weir I know of on the river which can be raised entirely out of the water, leaving the full breadth and depth of the river clear of any obstruction. I believe it is Stoney's patent, and it is the nearest approach to what I think would remedy the situation. Maybe there are others similar in effect.

It will probably be advanced that the tidal water will always hold up the flow of water downstream, which I will admit, but if you can get rid of the water in small streams, brooks, and ditches during the period of low tide, you have a vacant space which will take up a great deal of water, which now causes the waterlogged land to flood.

There may also be a contributory cause by reason of the river not being properly dredged and so being incapable of holding as much water as it would do. For instance, at the outlet to Broom Water in the main river there used to be a depth of 5ft. to 6ft. close inshore. Now there are only about 6in. There are other places I know in the vicinity which have nothing like the depth of water they used to have.

However, as the recent disasters will undoubtedly cause the reasons why to be inquired into, and thinking that the opinion of an outsider may help to bring a fresh view point into consideration, is the reason I have written to you.

Teddington, January 11th. A. E. LANGLEY.

COMPOUNDS ON RAIL AND SEA.

SIR,—Your correspondent Mr. Riekie, in your issue of the 13th inst., is, I venture to suggest, working from the wrong end. A compound engine, or any other for that matter, should be designed to develop the required power and not to absorb a given quantity of steam. Now the fundamental question between compound and simple locomotives is not whether the increased expansion possible with a compound is desirable, as a simple can expand any normal pressure as low as desired, but is whether it is better to carry out all the expansions in one stage or in two stages. With ultra-high pressures, it is, of course, another matter.

If this is granted, it is obvious that the volume of the low-pressure cylinders of the compound will be equal to that of the cylinders of the simple engine, and while the maximum rate of expansion is being used the size of the high-pressure cylinders only affects the proportions in which the power is divided between the two groups. Of course, the larger they are, the more nearly the range of expansion will approach that of the simple engine.

The large rate of expansion advocated by Mr. Riekie, while probably possible with steam chest pressures above 200 lb. per square inch, would most certainly entail vacuum loops in the expansion curve when running light, and with Mr. Riekie's size of low-pressure cylinders it would mostly be light running.

As I have suggested previously, the desired flexibility of the compound may be obtained by increasing the high-pressure cylinder size considerably above that usually employed; in this connection, I would suggest that the compound locomotive has suffered by a too slavish copying of the marine engine, where, of course, the high-pressure cylinder size is limited by the necessity of keeping the maximum loads and mean loads of each line as near as possible equal. In a locomotive, while it is still desirable to keep the mean loads equal, it is of not great importance if the maximum high-pressure loads are in excess of the low-pressure, as the outside rods are of necessity quite different from the inside rods, and, of course, all the rods have to be strong enough for the starting effort. The large high-pressure cylinder incidentally allows equalisation of the mean loads without receiver drop, which is always present when equal mean loads are obtained with the usual size of high-pressure cylinder.

C. M. KEILLER.

Cookham Dean, Berks., January 16th.

NEW TYNE BRIDGE.

SIR,—I am surprised to read in your issue of the 13th inst. that Thos. H. Webster claims to have been the originator of the New Tyne Bridge. The scheme for the building of a bridge across the Tyne on the present site or close to it dates back to 1883. On August 1st of that year the Newcastle and Gateshead Councils passed resolutions that a free bridge should be constructed across the Tyne, jointly by the Corporations of the two towns, and instructions were given for a joint conference to consider the matter with a view of an application to Parliament in the ensuing session. On September 10th, 1883, the *Newcastle Chronicle* published a sketch of a bridge prepared by the City Engineer, which, singular to say, is almost the identical bridge that is now approaching completion. For various reasons the joint bodies could not come to any agreement and the matter remained in abeyance until 1890, when it again came to the front by the publication in the papers of a bridge prepared by Mr. Laws, City Engineer. In 1893 once more it was revived by the scheme for a Newcastle and Manchester Railway. In 1897 came a bridge designed by Messrs. Moncrieff and Sandeman, who exhibited a large model of their bridge in the Newcastle Town Hall. In 1899 Mr. Benjamin Plummer came forward with another scheme. From 1900 several attempts were made to revive the scheme by Councillor William Cowell, the Chairman of the Bridge Committee. His death in 1910 and the Great War ended the matter for the time. In the summer of 1922 once more the matter was revived by letters in the Press by Messrs. H. Y. Richardson and Webster, and the promise of a grant from the Government gave the scheme the last push to accomplishment.

January 16th. WALTER HAYLER.

A COMPRESSED AIR METER.

SIR,—In your issue of December 30th you reprint a paper by Mr. E. J. Laschinger on what is called a "New Form of Compressed Air Meter." This type of meter, which comprises a weighted door hung on horizontal hinges in the airway, was first applied to compressed air measurements by the writer in 1910, and weighted door air meters of the writer's design having the most desirable form of the scoop on the downstream side of the door for the particular purpose in view, have, since 1911, measured 150 million horse-power hours per annum on the Witwatersrand.

The shaped scoop shown in Mr. Laschinger's Fig. 5 was first introduced by the writer in 1912, and the slotted plate to give equal spacing in 1914. The theory given in Mr. Laschinger's paper for deriving the shape of the slot is futile, as it is not possible by its means to calculate the shape with sufficient accuracy to avoid calibration of each meter.

In conclusion, the writer's firm, Geo. Kent, Ltd., have made water meters of the type described as now by Mr. Laschinger for some twenty-five years.

JOHN L. HODGSON, M.I. Mech. E.

Leighton Buzzard, January 14th.

BOX CONTAINERS.

SIR,—Referring to the paragraph on "Railway Matters" in your issue of January 13th, may I call your attention to a much earlier use of box containers?

In 1848, in the days when the public in Edinburgh demanded that coal should be supplied in large lumps, a Mr. John Wilson owned a colliery near Falkirk which produced "very rich, but extra soft coal." The pit was some distance from the Union Canal, by which the coal was conveyed to Edinburgh, thus necessitating three transfers before the coal was delivered, by which time it was so broken as to be practically unsaleable. But the difficulty was overcome by Mr. Wilson, who invented box containers, which were loaded at the pit, placed on skeleton trucks, lifted into the barges, and finally conveyed on special carts to the customers. The coal was thus delivered without breaking bulk, to the immediate pecuniary advantage of Mr. Wilson and to his ultimate honour as, probably, the original inventor of containers for goods in bulk.

Edinburgh, January 17th. THOS. ROWATT.

Canadian Engineering News.

(From our own Correspondent.)

Mineral Development in New Brunswick.

ANOTHER important step has been taken in connection with mineral development in the province of New Brunswick, Canada, which promises extensive operations of copper mines in King's County, the ore from which is reported to have assayed a considerably higher percentage of copper than the output of the famous Noranda mine in the Rouyn district of Quebec. Preliminary investigation work, which has been carried on at the property situated near Annindale, has attracted the Canadian International Corporation, of Montreal, sufficiently for it to acquire an option on one square mile, which the owners have held for some years. On behalf of the Corporation, control of adjoining property has also been secured by Brigadier-General Charles A. Smart, of Westmount, Quebec. Confirming the reports that interests with which he is identified have taken over the Annindale mine, General Smart said that it was the intention to install a concentrating plant on the property. The plant, he said, would be within 400 yards of the New Brunswick Coal and Railway Company's line, which is operated by the Canadian Pacific Railway. It is planned to make shipments largely to Swansea, in Wales. The process which will be used for concentration has not yet been determined.

The St. Lawrence Waterway.

According to a recent announcement by Mr. King, Prime Minister of Canada, early action on the St. Lawrence deep waterway scheme is contemplated by the Dominion Government. With the receipt of the printed report, with appendices, of the Joint Board of Engineers named by the United States and Canadian Governments, to inquire into the various phases of the project, intimation was made to the National Advisory Council of Canada that it should meet to consider the report and be in a position to confer with a Committee of the Federal Cabinet some time in January. The United States Government has expressed itself desirous of proceeding at once with the negotiation of a treaty, and the Canadian Government's present activity would indicate that definite steps are to be taken before long. In the meantime the annual report of the Federal Department of Railways and Canals has been issued. In it it is pointed out that completion of definite plans for the ultimate enlargement of the St. Lawrence Canal system between Lake Ontario and Montreal has become necessary to enable the department to deal "intelligently with proposals by private corporations for the development of isolated water powers which might seriously conflict with any reasonable development of the navigation and power potentialities of the river as a whole."

The Limoilou Paper Mill.

The big newsprint mill of the Anglo-Canadian Pulp and Paper Company at Limoilou, Quebec, has started operations, and it is anticipated that during the course of the next twelve months the plant will be operating at a capacity of 500 tons a day. The company is controlled by British capital. Lord Rothermere is president. Foundation work on the mill was started in November, 1926, and the installation of equipment for paper production began in July of 1927. Thus it is probable that all time records for the construction and equipment of a paper mill of similar capacity will have been broken. The plant has been so designed that at a later date the output can be increased to 1000 tons daily at a comparatively low construction cost. Machinery of the most modern type has been installed throughout, the paper machines having been built by Walmsleys, in England. It is interesting to note that 7,000,000 dollars have already been spent on construction, of which amount 3,000,000 dollars was spent in Great Britain. The steam plant is modelled after the modern large central station plan with full automatic control, and is the only 40 lb. steam pressure plant in Canada. Steam at boiler pressure is first expanded through a steam turbine before delivery to process, thereby enabling electric power to be obtained as a by-product of

process steam requirements. This installation is novel in that the turbine is designed to operate in parallel with purchased power, delivering power only as a by-product of the process. The new mill is one of the first paper plants to use power developed at Isle Maligne, on the Saguenay River, The use by this plant of so large a quantity of power assists materially in the carrying out of the provincial programme for the development of Quebec water-powers for the benefit of Quebec industries.

A Big Electric Smelter.

Announcement was made in Quebec a short time ago by Hon. Adelard Turgeon, president of the Canadian executive of the British Syndicate, formed to undertake important industrial developments in the province of Quebec, that a big electric smelter to treat the minerals of Gaspe Peninsula, will be built in or near the city of Quebec. The smelter, Mr. Turgeon stated, would be built especially to treat the zinc and lead mined in Gaspe, where development is proceeding at a rapid pace. "Our idea would be," Mr. Turgeon said, "to remove the present difficulty of inadequate transportation, by bringing the ore to the smelter at Quebec city by boat, a very cheap means of transportation. Development work going on in Gaspe gives signs of big things, and a smelter would advance the industry to an enormous extent." Speaking of the power necessary for the smelter, Mr. Turgeon said that he understood that about 5000 horse-power would be required for each unit. He had learned, he added, that the power at Quebec city would cost about 2 dollars per horse-power more than it would in the Isle Maligne region, where the Duke-Price power plants are situated, but that it was possible that, in time, some arrangement could be made for a lower rate in Quebec if the power were used to a great extent, as it would be in smelting. Two smelters are already built in the province of Quebec. One is at Noranda, to treat the copper ore of the Rouyn district. This is a coal smelter, but the one built by the American Aluminium Company for its big mill at Arvida is driven by electricity, the power being obtained from Isle Maligne. The power-house at the latter—a view of which is given in the accompanying engraving, and which is on the Saguenay River—was built by the Duke-Price Power Company. It will have an ultimate capacity of 540,000 horse-power.

THE ISLE MALIGNE POWER-HOUSE ON THE SAGUENAY RIVER

SIXTY YEARS AGO.

WHEN sails went out and steam came in the incidental changes wrought were many. Among those of a minor order was the fact that ships no longer required ballasting. In the British Navy the ballast used in the old sailing ship days was pig iron. The pigs had to be cast to certain standards. In 1815, for instance, the Navy's contract for ballast stipulated that the iron was to be "good, sound, merchantable, and not to break," and that it was to be supplied in two sizes, the large pigs measuring 3ft. long and 6in. square and the small pigs 18in. long, 6in. broad and 4½in. deep. Five cubic feet of pigs were to weigh 1 ton. As the sailing ships returned from their last voyages they landed their ballast at the dockyards, and in the course of time the accumulation of pigs became something of an embarrassment. At one time the stocks of ballast at the dockyards amounted nearly to 40,000 tons. Many attempts were made to dispose of the material, but little success attended them. The firm responsible for the 1815 contract bought back 1000 tons, but except for 170 tons of pigs made in France, the metal was found unsuitable for foundry purposes. Other small parcels were sold. Between 1860 and 1866 the total amount disposed of was 1823 tons, and the price obtained averaged about 47s. per ton. The dockyard authorities, fearing, presumably, that the iron would remain for ever on their hands, decided to make use of it in an original way. They used it for making the roads in the dockyards. Excellent roads, it seems, resulted. The old roads had shown much deterioration and were proving costly to maintain under the increased weight of traffic over them consequent upon the increased weight of machinery and armour plate employed in the newer steam vessels. Naturally, this use of good cold blast iron for which as much as 47s. per ton had been obtained soon reached the ears of the parliamentary economists of the time. In particular, Mr. Seely took up the question, and hotly attacked the Admiralty for its extravagance. At first we appeared to support Mr. Seely, but on going further into the subject, we recanted and for once raised our voice in defence of the Admiralty. In our issue of January 17th, 1868, we took pains to explain the situation. Apart from the excessively large size of the pigs, we pointed to the fact that the iron was far from being uniform in quality. The examination of twelve pigs received from one dockyard showed that among them there were seven different sorts of iron. For puddling purposes or for use in the foundry it would have been necessary to assort the pigs by breaking and examining each one separately. The cost of so doing and of re-making the roads with granite setts or macadam would have been much more than any profit that could have been realised by the sale of the pigs. Unless the sorting were most carefully performed the iron would have speedily acquired a bad reputation among those using it, with the result that the demand for it would fall away to nothing. On the whole, we concluded, it would be much the best plan to leave the iron where it was.

CONCRETE ROAD AT A HIGH ALTITUDE.

THERE has recently been laid in Inverness-shire a length of all-concrete road which will, in all probability, have to withstand more severe climatic conditions than any other concrete road in Great Britain. This stretch, which traverses the extensive peat bogs that lie at an altitude of about 1200ft. above sea level between Carrbridge and Tomatin in Inverness-shire, forms part of the scheme of reconstruction of the road across the Grampians between Perth and Inverness. The problem as to how traffic was to be carried across these bogs was solved by laying on top of the peat a concrete raft about half a mile long and 21ft. wide. Owing to the isolated position of the road, it was impossible to divert traffic during reconstruction, so that the raft was laid in two halves, and in order to allow for the expansion and contraction which will take place, owing to the extremes of temperature which are likely to occur at this altitude, expansion joints have been inserted across the road at average intervals of 50ft. To eliminate any risk of vertical movement between the slabs thus formed, there have been inserted at intervals along the longitudinal and transverse joints, special dowel bars, which have been so designed that, although they prevent vertical movement, they do not interfere with any longitudinal or lateral movement which may be caused by extremes of temperature. To prevent the soft peat from being squeezed out from beneath the raft when loads travel along it, each slab is constructed in the form of an inverted trough, the sides of which are about 10in. deep and 6in. wide.

The raft is 8in. thick, and is strongly reinforced with top, bottom and shear reinforcement to enable it to withstand the severe stresses which will be developed, owing to the unstable condition of the subsoil on which it is laid. The raft was designed by Major Robert Bruce, M. Inst. C.E., Chief Engineer of the Inverness–Perth road, and the work was carried out by Messrs. John McAdam and Sons, of Aberdeen, under the supervision of Mr. Frank Shand, the Resident Engineer.

THE gross tonnage of vessels handled at Southampton during last year amounted to some 15,200,000 tons, inward, as compared with 14,600,000 tons for the previous twelve months. The outward tonnages were slightly less in both cases.

The Institution of Civil Engineers.

OCTOBER EXAMINATIONS, 1927.—PASS LIST.

Preliminary (69).—H. St. C. P. Andrews, J. Banning, W. Bowden, F. E. Bowring, T. H. Carden, E. B. Clark, H. M. Collins, W. H. B. Cotton, I. A. Cromie, W. A. Cross, R. P. Davis, G. B. Dersley, A. N. Duder, A. H. Eydmann, R. P. Fish, G. F. Fitzherbert, J. R. Freer-Hewish, H. T. Frost, K. W. Gent, A. R. Gillespie, N. W. Hampson, E. L. Harding, R. E. Hethering-ton, H. W. Hinitt, C. Hodgson, B. Holroyde, E. A. O. Holst, W. R. C. Inkpen, P. D. Jansz, D. A. Lane, F. M. McCullough, S. McGregor, A. McIvor, I. W. McKinnon, F. Margerison, G. A. Mather, W. H. Moore, L. J. B. Morris, R. Neesham, J. L. L. North, C. J. Oliver, C. J. W. Parsons, F. Pettinger, B. T. Rees, J. D. H. Reid, J. A. S. Rolfe, E. F. Scott, F. D. Scott, R. D. J. Scott, W. B. Shannon, A. E. Shaw, C. J. S. Sims, G. B. C. Smyth, N. A. Spencer, V. E. Stanbridge, T. H. Stayman, G. F. Steadman, J. B. Storey, W. J. Syme, R. W. Tate, J. Tomlinson, E. A. Turner, R. E. Tweedale, H. G. J. Watson, O. F. Westgate, W. L. Whately, D. J. MacG. Williamson, S. C. Wilson, R. D. Young.

ASSOCIATE MEMBERSHIP (296).

Whole Examination (Sections A, B and C) (15).—J. W. Allison, T. N. Blockley, W. G. A. Clark, A. E. Crisp, G. L. A. Downing, A. D. Hughes, D. R. Hunt, T. C. Ketchen, J. H. Kleynhans, F. W. Lindup, H. A. Robinson, L. F. Row, H. G. Trivedi, J. N. Vakil, E. N. Ward.

Sections A and B only (17).—G. Allen, G. R. Carle, B. W. Charman, A. E. Clark, S. M. Davies, T. P. Fox, R. Inglis, P. M. C. Lindesay, J. H. Lovett, R. A. Mirams, J. V. Paterson, J. S. Robertson, C. P. Shelbourne, F. Unwin, T. D. Watson, S. R. Williams, R. Wyllie.

Sections A and C only (2).—H. H. Collette, C. E. Whitcombe.

Sections B and C only (12).—R. G. Booth, J. Campbell, W. C. Clarke, R. B. Craig, E. R. Harris, R. V. T. Hoskings, W. G. McCarthy, L. L. Meadowcroft, K. Seymour, H. Snape, W. R. White, W. F. Young.

Section A only (48).—E. H. M. Adams, J. C. Ballantine, G. J. le B. Beaumont, A. Begleman, J. B. R. Brooke, F. H. Clark, N. Cobein, H. F. Commerford, N. Cook, T. Cooper, B. W. Davies, H. Duckworth, A. C. Dunthorne, J. Gadsden, J. H. Goodridge, A. Grant, G. G. Gwilliam, C. H. Hales, D'A. O. Haskell, C. T. Henfrey, F. B. Hollis, J. D. How, J. Hurrell, B. E. Ireland, S. K. M. Iyer, K. F. Jones, J. H. Langton, J. P. Larkin, A. C. L. Law, W. J. Litherland, D. E. Morse, J. H. Murray, J. A. Pidgeon, T. H. Prince, G. R. Prosser, L. W. Roberts, W. J. Smith, C. W. Spencer, G. L. Stratton, E. E. Sweeting, C. M. Teulon, W. E. Thorowgood, G. M. Vibart, G. E. Walker, L. E. Williams, F. T. Wood, R. F. Wycherley, J. H. Young.

Section B only (26).—W. G. M. Anderson, N. B. Bennett, C. H. Bradbury, W. H. Burren, L. Carnie, B. N. Chatterjee, W. A. Clarkson, H. M. Colman, E. J. Davies, I. N. Deakin, A. W. B. Gill, J. McP. Gordon, D. Hide, J. R. Kanga, W. M. Law, J. Mackie, F. W. Petre, F. S. Snow, E. R. Stables, R. Stent, M. W. Summers, B. W. Sutherns, F. W. Taylor, M. J. Thomas, R. O. Tomkins, S. L. Vincent, R. J. Williams, W. O. Wright.

Section C only (174).—A. Adlington, C. E. K. Alcock, R. P. Alexander, B.Sc. (Belfast), P. J. Alley, B.E. (New Zealand), P. M. Anderson, B.A. (Cantab.), S. M. Anwyl, B.A. (Cantab.), R. H. Austin, D. C. Bailey, B.Eng. (Sheffield), P. Banerjee, R. C. Bestow, B.Sc. Eng. (Lond.), R. T. Betts, B.Sc. Eng. (Lond.), J. Bickley, B.Sc. (Birmingham), J. M. Billing, B.Sc. Eng. (Lond.), J. Blackburn, F. S. Bloomfield, B.A. (Cantab.), N. S. Boulton, B.Sc. (Birmingham), S. R. Boyd, B.A.I. (Dubl.), J. H. Brooks, B.Eng. (Liverpool), C. V. Brown, C. W. E. Brown, D. D. Buchanan, B.Sc. (Edin.), C. A. F. Cairns, J. N. McK. Campbell, B.Sc. Eng. (Lond.), R. D. Carr, B.Sc. (St. Andrews), N. R. Carter, F. H. Coleby, K. H. B. Collier, H. F. C. Colman, B.Sc. Eng. (Lond.), A. J. Consacher, R. N. Cove, B.Sc. (Bristol), A. Cowie, R. F. B. Crook, B.Sc. (Glas.), E. R. Davies, E. S. G. De la Motte, B.A. (Cantab.), E. L. Diamond, B.Sc. Eng. (Lond.), J. P. Y. Dickey, B.Sc. (Manchester), F. Dickinson, W. G. Donaldson, T. Doughty, B.Sc. (Edin.), J. Duvivier, B.Sc. Eng. (Lond.), R. G. Edkins, B.A. (Cantab.), W. H. Elgar, B.Eng. (Sheffield), E. V. T. Ellis, B.A. (Cantab.), T. E. Emmett, W. H. Evans, B.Sc. (Witwatersrand), H. H. Facey, J. R. Farquharson, B.Sc. (Glas.), H. R. Farrington, C. W. Firth, A. A. Fulton, B.Sc (St. Andrews), A. J. Gardiner, E. J. Garlick, G. A. M. Gentry, W. R. Gibson, B.Sc. (Edin.), R. Grab, B.Eng. (Sheffield), A. H. Greenham, B.A. (Cantab.), J. R. B. Griggs, B.Sc. Eng. (Lond.), A. A. Gross, B.Sc. (Birmingham), C. A. Hadcock, B.A. (Cantab.), R. H. Hall, B.Sc. (Cape), W. E. de C. Hamilton, B.A. (Cantab.), J. H. Hanning, B.Sc. (Edin.), C. Hargreaves, B.Sc. Eng. (Lond.), A. G. Harris, B.E. (New Zealand), R. A. Harrison, H. S. Heath, R. B. Heseltine, E. Hoyt, P. G. Hudson, B.Sc. Eng. (Lond.), W. B. Instone, W. H. Jackson, J. Jagger, B.Sc. (Leeds), J. I. Jammy, B.Sc. (Edin.), A. H. Jardine, B.Sc. (Cape Town), N. V. Jeffery, R. W. Jenkins, B.A.I. (Dubl.), G. C. K. Jolley, B.A. (Oxon.), H. S. Keep, B.Sc. Eng. (Lond.), E. L. Kelting, E. J. R. Kennerell, B.Sc. Eng. (Lond.), G. F. Kent, M. Kesvan, J. McE. King, A. C. Korner, T. T. Lambe, B.Sc. Eng. (Lond.), S. A. Lambert, C. F. Lapworth, B.Sc. Eng. (Lond.), G. T. Leithhead, B.Sc. (Edin.), J. W. B. Leng, B.Sc. (Durham), J. W. Lewis, B. Lillie, B.Sc. Eng. (Lond.), H. R. Lillie, B.Sc. (St. Andrews), C. F. J. Lisle, B.Sc. (Birmingham), W. Livingston, J. W. Lowdon, B.Sc. Eng. (Lond.), J. Lowe, B.Eng. (Liverpool), J. B. Lund, G. H. Lunt, A. H. McBride, B.Sc. (Glas.), R. H. MacDonald, B.A. (Cantab.), T. McIntyre, B.Eng. (Sheffield), A. S. Maclaren, B.A. (Cantab.), J. F. Main, I. McL. Malcolm, H. E. Manning, B.Sc. Eng. (Lond.), D. B. Martin, B.Sc. Eng. (Lond.), O. J. Masterman, B.E. (Tasmania), D. G. Mead, J. D. Michael, B.Sc. (Edin.), T. R. T. Middleton, B.Sc. Eng. (Lond.), J. D. Midforth, H. Milne, A. Mitchell, F. L. W. Morison, B.E. (W. Australia), J. F. H. Nicolson, M.C., W. L. North, F. C. T. Nutter, A. A. Paul, B.Sc. (Glas.), J. G. Pauling, G. W. Power, B.Eng. (Liverpool) P. U. Proudfoot, B.Sc. (Edin.), J. Reed, B.Sc. (Edin.), A. K. Richards, C. G. Roberts, M.C., B.Sc. Eng. (Lond.), W. M. L. Roberts, B.Eng. (Liverpool), R. G. Robertson, B.A. (Oxon.), W. A. R. Robertson, L. G. B. Rock, B.Sc. Eng. (Lond.), L. W. Rogers, W. T. Rondel, W. S. Rope, B.A. (Cantab.), E. L. Rushbrooke, F. C. Ryland, B.A. (Cantab.), H. Schrader, B.Sc. (Cape), J. E. Scrase, B.Sc. Eng. (Lond.), J. Shaw, J. H. Shennan, B.A. (Cantab.), J. W. Simpson, B.Eng. (Liverpool), D. G. Skitt, G. Smellie, R. W. C. Smith, R. W. Stanton, B.Sc. Eng. (Lond.), K. F. Starling, B.A. (Cantab.), W. Strother, G. B. H. Sutherland, B.E. (Sydney), R. A. Sutherland, B.Sc. Eng. (Lond.), J. N. Taylor, B.Sc. (Manchester), A. K. Terris, B.Sc. (Edin.), H. A. Thomas, B.Sc. (Wales), P. W. Thomas, B.Sc. Eng. (Lond.), J. H. H. Thompson, B.Sc. (St. Andrews), M. Thompson, B.Sc. (Durham), J. R. Thomson, B.Sc. (St. Andrews), J. R. Thorpe, B.A. (Cantab.), J. E. Toop, H. K. Tuck, B.A. (Cantab.), F. Tunnell, B.Sc. Eng. (Lond.), T. R. Tyagarajan, D. P. Viljoen, B.Sc. (Witwatersrand), L. R. Waddington, B.A. (Cantab.), M. J. Wardle, G. W. Warr, jun., L. R. Warren, B.Sc. (Birmingham), J. B. Watson, B.Sc. Eng. (Lond.), W. R. Watson, B.Sc. Eng. (Lond.), H. S. Weatherhead, B.Sc. Eng. (Lond.), H. Whipp, B.Sc. (Manchester), H. N. Wilford, C. W. M. Williams, B.Sc. (Wales), G. Wilson, B.Sc. Eng. (Lond.), K. C. Wilson, K. F. W. Woods, F. L. Wooldridge, F. L. D. Wooltorton, B.Sc. Eng. (Lond.).

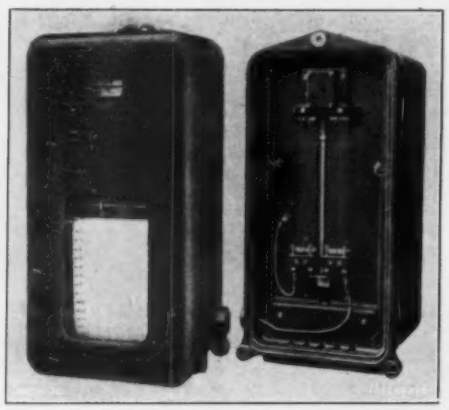
Physical and Optical Societies' Exhibition.

No. II.*

FOR central station use many ingenious instruments have been devised, and the latest is a wave form indicator which enables the voltage and current wave forms to be examined at any time. This new instrument, which was exhibited by the Cambridge Instrument Company, and which may also be employed for lecture and demonstration purposes, is shown in Fig. 11. A beam of light from a metal filament lamp is focussed on to a mirror attached to a coil held in

FIG. 11—WAVE FORM INDICATOR—CAMBRIDGE

the gap of a permanent magnet by stretched suspensions adjusted so that the coil vibrates in mechanical resonance with the frequency of the current passing through it. The reflected beam is focussed on to a system of mirrors which is rotated by means of a small synchronous motor driven from the source of supply, the wave form of which is being investigated. The beam is thus given a deflection, proportional to time, in a direction at right angles to the original deflection, which is proportional to the current passing through the coil. A transparent screen is placed in the path of the reflected beam so that an apparently stationary trace of the wave form is obtained. To enable voltage and current wave forms to be traced simultaneously, a commutator attached



FIGS. 12 AND 13—RECORDING POTENTIOMETER

to the shaft of the rotating mirrors, connects the coils alternately (1) in series with a non-inductive resistance across the mains, and (2) across a shunt which is fed from a suitable current transformer. The value of the resistance is such that rather less than 0·1 ampère passes through the coil. As the wave forms are taken on the same circuit, the correct phase relation is shown on the screen. The natural period of the vibrating coil is about 0·001 second. The apparatus is enclosed in a compact aluminium case, and the illumination is such that the wave forms are easily visible in a well-lighted room.

Another no less interesting exhibit on the Cambridge Instrument Company's stand was the recording potentiometer shown in Figs. 12 and 13, which is designed for the accurate measurement of small differences of potential. It is of the slide-wire type, but instead of the slide-wire contact being adjusted by hand until a balance is obtained, the adjustment is made automatically by the recorder mechanism. The galvanometer, which is connected in series with the unknown electromotive force—for example, a

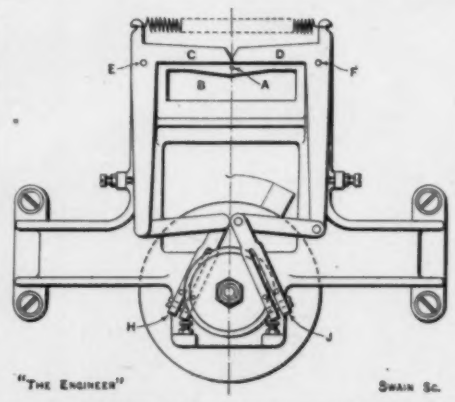


FIG. 14—RECORDING POTENTIOMETER MECHANISM

thermo-couple—acts as mechanical relay, which, on being deflected, sets in motion a mechanism which moves the contact on the slide-wire in a direction that tends to reduce the deflection. Thus, the circuit is always maintained in balance and the position of the contact along the slide-wire is a measure of the unknown electromotive force. The galvanometer is of the moving coil type, and has a long pointer with a cylindrical tip. This needle A—Fig. 14—swings

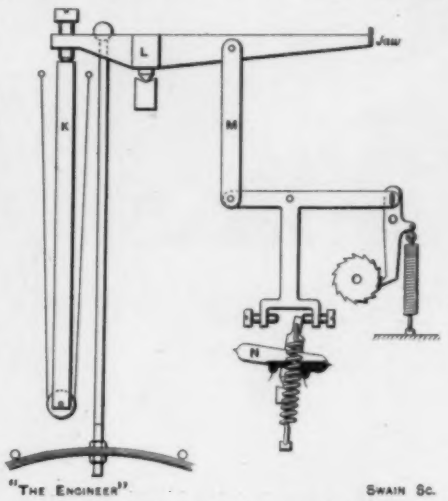


FIG. 15—HOT WIRE MOTOR MECHANISM

horizontally above a horizontal metal jaw B, which is raised periodically, and below the horizontal members C D of two bell crank levers, which are pivoted on the frame casting at E and F. When the circuit is out of balance the needle A is clamped by the lower jaw B against one of the upper horizontal members, thus causing the corresponding lever to tilt. This motion of the lever operates a clutch mechanism H or J, which ultimately results in the movement of a contact round a circular slide wire, and in the corresponding movement of a pulley carrying a cord to which the recorder pen is attached. The pen moves on a horizontal rod, so that the rotation of the contact is translated into a linear motion of the pen across the recorder chart. Similarly, if the galvanometer pointer is pressed against the other horizontal member, the other bell crank lever is operated, and the recorder pen moves across the chart in the opposite direction. The chart, which has to be renewed monthly, is driven by clockwork at a speed which may be varied from ¼in. to 2in. per hour. The record space is 80 mm. wide. The recorder chart is wound automatically as described below, the paper speed being controlled by an escapement.

The power required to raise the lower jaw and to wind the clock for the recorder chart is obtained from a hot wire motor mounted in the back of the recorder case, as shown in Fig. 13. It may be energised from any electric lighting or power circuit, either direct or alternating, up to voltages of 400. The hot wire is wound on a series of upper and lower pulleys, the upper pulleys being carried on a frame fixed to the recorder case, while the lower pulley frame is free to move, and carries a vertical push rod—shown at K, Fig. 15—which bears against one end of a horizontal lever L, the other end of which forms the lower jaw of the galvanometer relay mechanism. A spring maintains the lever in contact with the vertical push rod, and keeps the hot wire taut. The lever also actuates, through a vertical link M, the mechanism which operates a tilting mercury switch N and also a spring-controlled ratchet mechanism O, which winds the clock for the recorder chart. When a current passes through the wire, it heats and expands, causing the push rod to move downwards, and the consequent movement of the horizontal lever raises the lower jaw against the galvanometer pointer, and at the same time causes the mercury switch to tilt, thus breaking the circuit. The hot wire then cools, and the lever returns to its original position, thus restoring the circuit, and once again the cycle of operations is repeated. Owing to the extremely slow speed of the operations—normally, eight times per minute—wear and tear are reduced to a minimum.

The slide-wire is arranged to give a potential drop of 10 millivolts, but this range may be extended, as required, by means of auxilliary resistances connected in series with the slide-wire. Alternatively, a fraction of the voltage may be tapped off by means of a ratio box.

Mr. E. B. Moullin, of the Engineering Laboratory, Cambridge, exhibited three new patterns—see Fig. 16—of his thermionic voltmeter, all of which presented several features of interest. One pattern is a self-contained instrument for measuring the peak value and the mean value of an alternating voltage of any wave form. The instrument has a change-over switch and there are two scales on one dial. In one position of the switch the needle indicates directly on the upper scale the peak value of the alternating voltage applied to its terminals, whilst, when the switch is placed in the other position, the needle indicates directly on the lower scale the mean value of a half-cycle of the same voltage. The two scales are arranged so that the needle does not change its position if the applied voltage is a true sine curve. The instrument shown was calibrated so as to give full-scale deflection for a sine curve voltage of 240 (R.M.S.) and the scale is uniform. The effective input resistance is in the neighbourhood of 2 megohms, and the instrument consequently absorbs a negligible amount of power from the circuit to which it is connected. An interesting feature of the mean voltage scale is that it can also be used to measure a direct-current voltage directly by multiplying the reading by a scale factor of one-half. Thus, in addition to its extreme versatility as an alternating-current voltmeter, it is also a direct-current voltmeter, reading up to 110 volts, which takes only about 50 micro-ampères at full scale reading. The peak voltage scale is unaffected by a direct-current voltage superposed on the alternating current to be measured. No doubt the instrument will find many useful applications at supply frequencies when an oscillograph is not available. It also has many uses in audio frequency and radio frequency work. For example, it may be used to measure distortion produced by an audio frequency amplifier intended for broadcast or telephone repeater use. If the output voltage were measured by an electrostatic voltmeter distortion would not be very apparent because R.M.S. values are added to very little by superposed harmonics; but with this instrument both the positive and the negative peak values can be measured and also the mean value, and distortion thus becomes apparent.

FIG. 16—NEW MOULLIN THERMIONIC VOLTMETERS—CAMBRIDGE

The second instrument is intended mainly for radio

* No. I. appeared January 13th.

frequency work. It is a two-range voltmeter for 0–2–15 volts, and is calibrated in R.M.S. values of a sinusoidal applied voltage. The scale is approximately uniform and the range of satisfactory reading is about 25 : 1. The instrument is unaffected by a direct-current voltage, and, like the previously described pattern, requires no batteries except an accumulator for the filament of the valve.

The third instrument is suitable for frequencies up to a few kilocycles and is a three-range voltmeter with a range of 0–2–11–110 volts. Its most interesting feature is the shape of its scale, which allows the whole range of voltage to be covered by three ranges that give a 35 per cent. overlap between each. The useful range of reading is about 200 : 1 and the scale shape makes the percentage accuracy of reading of the same order everywhere. The instruments are made by the Cambridge Instrument Company,

The latest form of Dionic water tester was exhibited by Evershed and Vignoles. When the apparatus was first introduced, some twenty years ago, it was used mainly for testing boiler feed water, but since then it has been employed for several other purposes, such as that of checking condenser leakage. The

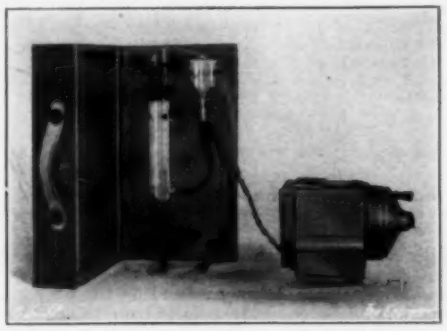


FIG. 17—DIONIC WATER TESTER—EVERSHED

demand for the apparatus has considerably increased, and it has been re-designed with a view to making it more compact and lighter. The principle of operation has not, however, been changed. The determination of the amount of inorganic impurity in water or other liquids is effected by measuring the electrical conductivity. As shown in Fig. 17, the apparatus consists of two parts, the water-tube section and the conductivity meter. The new form of water-tube is much more compact than that which was originally employed, and it can be mounted permanently on a panel, be placed on a bench, or be suspended in a vat or tank. As the conductivity of all solutions varies greatly with the temperature, a correction must be made for this variable either by means of a table or by some form of compensation. The compensation for temperature in the new form of "Dionic" water tester is exceptionally simple, and another advantage of the new instrument is that the water-tube can easily be taken out for cleaning, and any part can be replaced without affecting the calibration. Improvements have also been made in the conductivity meter. Two forms of conductivity meter are now available, one resembling the well-known "Meg" insulation

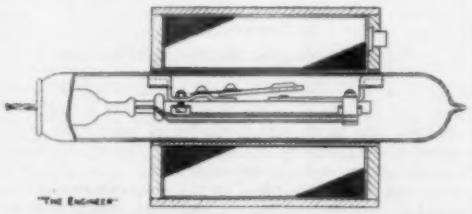


FIG. 18—VACUUM SWITCH—G.E.C.

tester, see Fig. 17, with a range of 0–5000 units, and the other resembling the megger testing set, which provides two or three ranges and has the advantage that it can be used to test relatively pure water, such as condensate, and impure water, such as ordinary boiler feed water, with equal accuracy. The new designs have resulted in a reduction in the cost of manufacture.

Among other things exhibited by the Research Laboratories of the General Electric Company were some vacuum switches, which are now in the experimental stage. As shown in Fig. 18 the switch mechanism is mounted in a glass envelope in which a high vacuum is produced. The switch is operated externally by an electro-magnet, which is in the form of an ironclad solenoid, that surrounds the switch, and forms a compact housing. When a circuit is broken by means of a switch of this type, the destructive arc associated with air and oil-break switches is practically non-existent. The wear on the contact faces is consequently very much reduced, and that results in a smaller and lighter form of construction, thus making the switches suitable for controlling circuits which have to be made and broken with great rapidity. One of the chief features of these switches is their ability to operate satisfactorily at high voltages.

The automatic photo-electric rating machine for testing electric lamps, which was exhibited last year, was again in evidence. It has now been made more completely automatic, and in its present form it is of considerable value to electric lamp manufacturers, who can sort out those lamps in which the voltage at the correct filament temperature falls within agreed limits, without relying on the human eye, and at a much greater speed than can be obtained with ordinary photometry, when working to the same degree of accuracy. The lamps are brought in turn over three pairs of photo-electric cells, one of each pair being red-sensitive and the other blue-sensitive. The ratio of currents through the cells is determined by the colour of the light, and is independent of its intensity. The machine is set by inserting a standard lamp and by adjusting the cells so that an electroscope pointer is at zero. The lamps to be tested are burnt successively at two voltages, one slightly

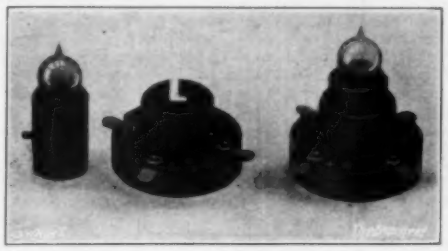


FIG. 19—VACUUM THERMO-COUPLES—ELLIOTT

above and one slightly below the correct value. If the electroscope deflections in these two cases are in opposite directions, the lamp falls inside these two limits and is passed, but if both deflections are in the same direction, the lamp is incorrectly rated and is rejected for that particular voltage. The machine is designed to handle 600 lamps per hour, and all the operator has to do is to insert and remove the lamps and observe the direction of the electroscope deflections. A method was also shown of using photo-electric cells to detect very small illuminations without the use of any sensitive apparatus. It depends on the fact that if a very small current limited by the external circuit, is forced through the cell by a potential greater than the sparking potential, the discharge will be intermittent and similar to the well-known "flashing" of a Neon lamp. Illumination alters the quantity of electricity passing at each "flash," and therefore the frequency of the "flashes."

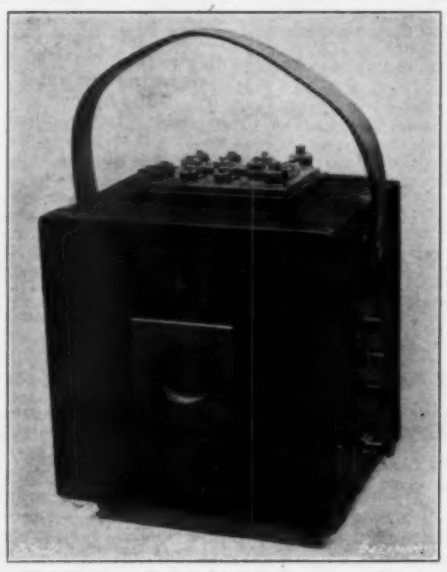


FIG. 20—CURRENT TRANSFORMER—ELLIOTT

Sensitive vacuum thermo-couples suitable for a heater current ranging from 5 milliampères to 5 ampères and capable of giving 12 to 14 millivolts on open circuit with the normal full-load current passing in the heater were exhibited by Elliott Brothers (London), Ltd. The couple is insulated from the heater by a special process which eliminates direct-current reversal errors and errors due to a "zero creep." For short periods the heaters are capable of withstanding an overload of 50 per cent. The couples can be supplied unmounted or mounted for use in bayonet holders, as shown in Fig. 19. Thermo-couples of this type are used in the company's high-resistance portable thermo voltmeters suitable for railway track signal relay testing. These voltmeters have a resistance of about 100 ohms per volt and can be made with ranges from 1·5 volt upwards. The instruments are independent of frequency variations, wave form and temperature. The "Multiversal" current transformer shown in Fig. 20—another exhibit on this company's stand—has been designed to give a large number of ranges with precision accuracy. The instrument has five self-contained ranges, and, by means of a cable wound through the central hole, ten additional ranges may be obtained, giving a total of fifteen ranges. The transformer is designed to stand a test pressure of 13,200 volts between the primary and secondary and the primary and iron for a period of one minute. The secondary, which is wound for a full-load current of 5 ampères, is provided with a self-contained short-circuiting switch to protect the transformer if it is desired to disconnect the secondary load.

The company's portable precision moving iron instruments as shown in Fig. 21 represent the latest advance in the design of moving iron instruments. By the employment of special alloys and careful design, the makers are able to guarantee a performance which is said to have hitherto been unobtainable in instruments of this class. When used with alternating currents of any commercial wave form or frequency, the accuracy obtainable is that of a sub-standard instrument as defined in the British Engineering Standards Specification No. 89 of 1926, and on direct-current circuits the errors are very little greater. All the instruments have knife edge non-resonant pointers and mirror scales, and external zero adjustment. They are efficiently screened from external magnetic fields. Ammeters and milliammeters of this type are accurate up to 500 periods, whilst the temperature, wave form and self-heating errors are said to be practically negligible. The periodicity errors of the voltmeters depend upon the current consumption, which has been chosen to give the best practical compromise. The stock windings are designed so that the periodicity errors are practically negligible from 15 to 140 periods per second. While the self-heating errors are inappreciable, owing to the watts consumed by the resistances, the instruments cannot

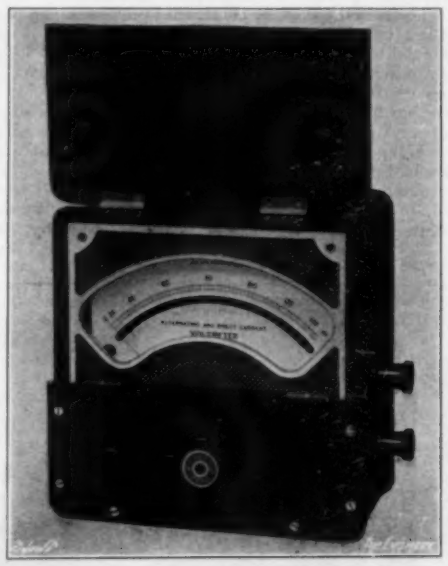


FIG. 21—PORTABLE A.C. VOLTMETER—ELLIOTT

be left in circuit continuously, and they are therefore provided with contact keys, which break the circuit when the finger is removed. For ranges of 120 volts and higher the current consumption is approximately 75 milliampères. Lower voltage ranges involve a higher current, according to the range, and, hence, it is not possible to combine in one instrument a number of widely different ranges. For voltages over 750 the makers recommend the use of a potential transformer in combination with a 120-volt instrument.

The variety of forms in which bakelite resin products are now obtainable was illustrated in an attractive manner by Bakelite, Ltd., 68, Victoria-street, S.W. 1. This company is the successor to the Damard Lacquer Company, Ltd., of Birmingham, and to Mouldensite, Ltd., of Darley Dale. Bakelite may be described as an artificial resin. Chemically it is a phenolic condensation product and is produced by the reaction of phenol or carbolic acid on formaldehyde. The material as produced in the first instance is a solid amber-coloured transparent substance, which is soluble in methylated spirits and certain other solvents. It melts when heated. It can also be produced as a thick viscous liquid resembling treacle, but otherwise possessing the same properties as the solid variety. The solid and the viscous substance represent the material in what is known as the A stage. The second, or C stage as it is called, is produced by heating the A material for some time at 130 deg. Cent. This treatment produces a chemical change, leading to the polymerisation of the substance. After it, the material becomes a hard transparent amber-coloured solid which will no longer soften when the temperature is raised, and which is insoluble in practically all solvents, which is unaffected by water or steam, and which has a high heat and electricity insulating capacity. In this form the material is not much more than half as heavy as aluminium—its specific gravity is 1·33—while its mechanical strength is good, its tensile strength being about 2½ tons per square inch.

Industrially, the material is supplied and used in a variety of forms. One of the commonest is the A

stage material in a granular powder state. This powder is formed into a wide number of articles of a technical, artistic, domestic or other character by pressing it in highly polished hardened steel moulds. The pressure applied varies from 600 lb. to 1500 lb. per square inch, and is maintained for three to five minutes. Simultaneously, the mould and its contents are subjected to a temperature of 130 deg. Cent., or a little higher. As a result of the combined treatment, the powder passes into a liquid state and flows into all corners of the mould, and later, when the mould is allowed to cool, the contents emerge as a hard solid article possessing a highly finished surface, and having all the properties associated with bakelite in the C stage. The ease with which metal inserts, such as terminals, can be placed in the mould before it is filled with powder, and the firmness with which such inserts are held in the finished article, is one of the most valuable features of the process. It is of interest to note that the material is without chemical effect on any metal, even silver, which may be inserted in it. For some purposes bakelite articles are moulded not from powder, but from sheets or blocks of the A stage material.

The C stage material is supplied and used for many purposes. It machines well, provided the tool is kept cool by means of a soap or other lubricant. On the stand at the Exhibition there was shown a helical pinion the teeth of which had been cut in the bakelite blank in an ordinary gear-cutting machine.

Of the other forms in which bakelite is supplied and used, we may mention that in which it is dissolved from the A stage in spirit and used as an insulating varnish, which is finished by stoving. As a viscous liquid, the A stage material is employed as a cement for binding abrasive materials into the form of wheels, and for other cementing purposes. In this application the cement, after the incorporation of the material to be bound by it, is brought to the C stage by stoving. The spirit varnish application has recently been used with the addition of colours to provide a clear hard indestructible dip for the outsides of electric bulbs. In a slightly different form the material is now being made as an enamel for protecting metals and chemical plant.

Among the several exhibits shown by Adam Hilger, Ltd., of London, we were particularly attracted by the "Mutochrome," a device demonstrated by its inventor, Mr. C. F. Smith, and described as a means of painting with light instead of with pigments.

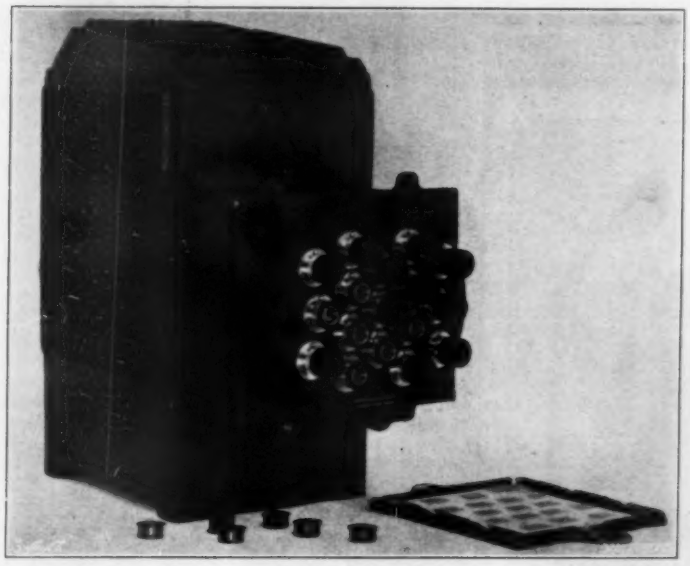


FIG. 22—SEVENTEEN-COLOUR "MUTOCHROME"—HILGER

Consider a pattern for a carpet, wall-paper or other subject in which there are, let us say, six colours, including the background. Let six lantern slides be made, each one representing by its clear spaces the areas to be covered by one of the colours and by its opaque spaces the areas assigned to all the other colours. If these slides are arranged side by side—for example, at the corners of a regular hexagon—and placed in a projector having six lenses, it is readily possible to arrange that the six images shall fall on the screen superimposed on one another. By means of coloured glasses slipped into position in front of the lenses the colouring of the different areas can be quickly varied. Further, if the lenses are fitted with iris diaphragms, the intensity of any one colour can be increased or diminished at will.

The "Mutochrome" is not only a projector; it is also a camera, and as such is used in the first instance for the production of the multiple slide. The artist or designer prepares from his original sketch six or more—or less—black and white drawings, each of which is blackened to correspond with those areas which are to have one common colour. These drawings are successively placed at the centre of the screen, which is later on to be used for projection purposes, and are photographed through one of the projector lenses on to a sensitive plate placed in a dark slide, temporarily substituted for the lantern slide carrier. A different lens is used for photographing each of the drawings. After all the exposures have been completed, the plate is developed, the clear spaces are increased in translucency by means of ferricyanide and hypo, and the black spaces are intensified by means of mercury and ammonia. The plate, when finished, presents the six or other number of negative photographs, each on a separate portion of the surface.

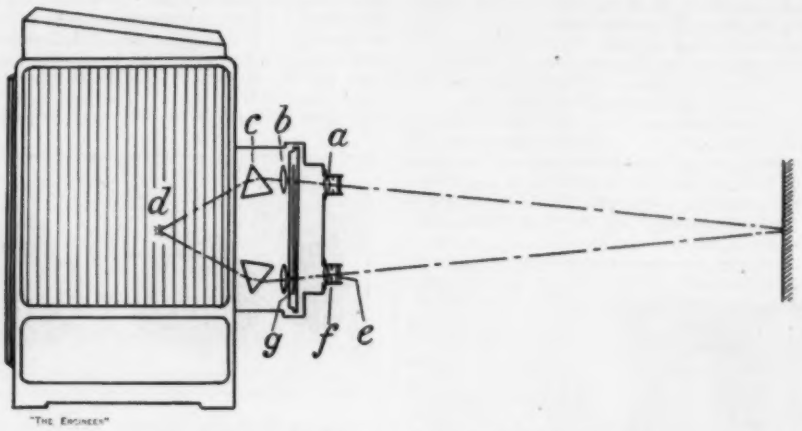


FIG. 23—SECTION OF "MUTOCHROME"—HILGER

If the plate is then inserted in the projector-camera, the conditions under which it has been made are such that all the six images will be superimposed on one another at the centre of the screen.

Given the outlines of a pattern, it is a matter of much time to present the pattern in a variety of colour combinations. To cover the complete range in a six-colour pattern 720 separate paintings would be required, and even then variations resulting from changes in the intensity of tint of any one of the colours would be excluded. In the case of wall-papers, in which as many as seventeen colours may be used on the one pattern, it is obvious that it is almost impossible at times to examine completely the effect of colour changes unless some ready means of effecting the changes, such as that provided by the "Mutochrome," is available. In the ordinary way, each colour of a wall-paper is applied by a separately inked roller. To study the effect of colour changes, the rollers are cleaned and re-inked. With the "Mutochrome," all the rollers are inked with black, and the printings from them are set up successively in front of the projector-camera for the production of the compound lantern slide.

In Fig. 22 we illustrate a seventeen-colour "Mutochrome," while in Fig. 23 a section of the apparatus is shown. The optical system consists of lenses *a*, condensing lenses *b* and prisms *c*. The colour screens are inserted at *e* in front of the iris diaphragms *f*. The photographic plate is placed at *g* for the purpose of making the lantern slide. That slide, when finished, occupies the same position and is illuminated by the source of light *d*.

The apparatus is made for seven, ten, seventeen or twenty-five colours. In addition to its application in the designing of patterns for wall-papers, textile fabrics, linoleums, carpets and so forth, the "Mutochrome" is of great interest in its possible application to the projection of theatrical scenery. For this purpose, it can be used to project actual scenes on a plain white background screen, and to permit the coloration of such scenes to be varied in any way desired by insensible gradations or otherwise. In addition to the creation of "jazz" effects, it enables the changes of colour accompanying the passage of the seasons or the rising and setting of the sun to be represented with remarkable effect. The apparatus should also prove useful in the theatre as a means of economising the time and money expended at present on the painting of scenery, for by its means it should be possible to reproduce on the full-size scale, say, 40ft. wide, a scene painted on a much smaller scale, say, 3ft. 6in. wide. We understand that the use of the instrument for scenery projection in a theatre has not as yet been actually tried at a public performance. The subject has, however, been fully studied. Particulars of the "theatre Mutochrome" were given by Mr. Smith in a paper which he read before the Optical Convention in 1926.

Another exhibit shown by Adam Hilger, Ltd., was the Fournier d'Albe system for the optical analysis of sound. This system makes use of a number of acoustic resonators, each consisting—see Fig. 24—of a cylindrical Helmholtz resonator, surmounted by a reed tune to the fundamental note of the resonator. The reed is of mica and at its end carries a small flat mirror of silvered glass. A ray of light from a lamp is concentrated on the mirror by an adjacent lens and is reflected on to a screen. There are twenty-four of these resonators in a set, the series covering a range of two octaves in steps of semitones of equal temperament. It is claimed that the resonators are highly selective, at least for all notes above the middle C, and that as a consequence the response of each resonator to notes other than its particular fundamental note is negligible. The apparatus does for sound what the spectroscope does for light. It enables a sound to be analysed in terms of the intensity pitch and duration of each note composing it. If the reflections from the mirrors are received on a moving sensitive film, a record of a sound can be obtained and by the employment of this record in conjunction with a selenium cell, a battery and a telephone, the sound can be reproduced.

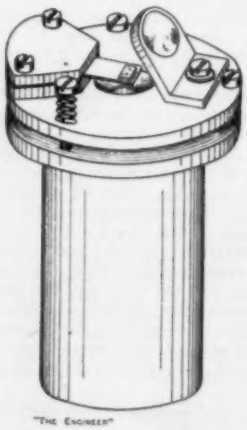


FIG. 24—ACOUSTIC RESONATOR—HILGER

(To be continued.)

CALENDARS, DIARIES, &c.

BRITISH BROWN-BOVERI, Ltd., London.—Wall calendar with monthly tear-off sheets.

WM. BROWN AND CO., Ltd., 2, Bury-court, St. Mary Axe, E.C.—Wall calendar with monthly tear-off sheets.

CANADIAN HYDRO-ELECTRIC CORPN., Ltd.—Wall calendar with monthly tear-off sheets.

C. AND S. CONSTRUCTION COMPANY, Bridgeway House, Hammersmith, W. 6.—Wall calendar with monthly tear-off sheets.

HUNSLET ENGINE COMPANY, Ltd., Hunslet Engine Works, Leeds.—Set of bi-monthly calendars for 1928.

C. ISLER AND CO., Ltd., Bear-lane, Southwark-street, S.E. 1.—Wall calendar.

PECKETT AND SONS, Ltd., Bristol.—Wall calendar with monthly tear-off slips.

A. C. POTTER AND CO., Grantham.—Pocket diary with memorandum book.

CHARLES ROBERTS AND CO., Ltd., Wakefield.—Two desk calendars with daily tear-off sheets.

WESTINGHOUSE ELECTRIC INTERNATIONAL COMPANY, 2, Norfolk-street, Strand, W.C. 2.—Pocket diary and wall calendar with monthly tear off sheets.

Railway Matters.

THE electrification of the Bombay, Baroda and Central India Railway between Church-gate Station, Bombay, and Bolivri was opened on January 5th.

ON the retirement, as from the 1st instant, of Mr. F. C. Stainton, the new works engineer to the Southern Railway, Mr. Conrad Gribble becomes assistant engineer (new works and bridges).

FOLLOWING the reference in this column on October 21st to the naming of the electric locomotives on the Metropolitan Railway, we note that the latest name so used is that of William Ewart Gladstone.

WHEN certain machines now on order have been delivered the number of ticket-issuing machines on the Underground system will be 220, and the number of slot machines, whence passengers obtain their tickets by the insertion of the requisite coins, will be 195, making 415 machines in all.

THE Mansion House Association on Railway and Canal Traffic—a relic of the railway rates controversy of the late 'eighties—has passed a resolution to oppose the railway companies' proposals as to road traffic on the ground that they will gradually deprive the trading community of alternative and *bona fide* competitive road haulage.

IT is officially announced that Mr. M. F. Keogh, the general manager of the Great Southern Railways, Ireland, will retire on May 1st. Mr. Keogh was the secretary of the Dublin, Wicklow and Wexford—later known as the Dublin and South-Eastern—until he went, in 1913, to the Midland Great Western as general manager, and on the grouping in 1924 of all the main line railways in the Free State as the Great Southern Railways he became general manager of the combined concern.

THE displacement of a conductor rail, which came into contact with a running rail, at Hampstead Heath on the evening of the 11th instant, caused flames to burst out in trains as far apart as Acton, Wembley, and Euston. It may be remembered that on November 7th, 1920, a displaced collector shoe on a train at Piccadilly Circus, on the Baker-street and Waterloo Railway, set up serious arcing, not only on its own train, but on one at South Kensington, on the Great Northern, Brompton and Piccadilly Railway.

THE main railway system of Iraq runs from Basra to Baghdad and on to Kirkuk, and is of the metre gauge, 624 miles long. There is also the standard-gauge line—built by the Germans as part of the famous Baghdad Railway—from Baghdad to Samarra, 74 miles, which was extended by the British as a war measure to Shargat, 112 miles further. In his recently issued report, Brigadier-General Hammond recommends that the metre-gauge line be extended to Mosul, 100 miles; that the line between Samarra and Shargat be abandoned; and that the Baghdad-Samarra section be converted to metre gauge.

THE Ministry of Transport has appointed a committee to review the recommendations made by the Electrification of Railways Advisory Committee of 1921 with respect to the standardisation of the electrical equipment of railways and other matters and to report what modifications, if any, should be made in those recommendations, having regard to the developments which have taken place since that date. The chairman will be Colonel Sir John Pringle and the other members are Sir John Aspinall, Mr. Arthur R. Cooper, Lieut.-Colonel Cortez Leigh, Sir Philip Dawson, Sir Alexander Gibb, Mr. H. N. Gresley, Mr. Herbert Jones, Mr. C. H. Merz, Sir Philip Nash, Mr. Roger T. Smith, and Sir John Snell, with Mr. Thomas L. Paterson, 6, Whitehall-gardens, S.W. 1, as the secretary. The previous Committee, we would remark, was appointed in March, 1920, as, undoubtedly, an outcome of the hope of Sir Eric Geddes, when Minister of Transport, that large economies could be effected by the electrification of railways. As one of the terms of reference related to work already done becoming part of a unified system—obviously the overhead contact system on the Brighton was in view—the Committee made an interim report on July 12th, 1920, recommending that that work remain as it was. The reference was enlarged in October, 1920, and the Committee made a final report on June 30th, 1921. During the six and a-half years that have elapsed since then many changes have been made in electrical operation, many of the recommendations already are out of date, hence the appointment of the present committee.

THE Ministry of Transport has appointed a committee to review the recommendations made by the Automatic Train Control Committee in 1922 and to consider and report what alterations, if any, should be made in that Committee's conclusions and recommendations, having regard to the developments that have taken place since that date. The investigations of the new committee will include the consideration of the non-contact type of train control, *i.e.*, inductive or wireless systems. No further examinations, however, will at present be made of devices, already considered by the Ministry of Transport, involving contact between apparatus on the track and on the locomotive respectively. The chairman will be Colonel Sir John Pringle and the Ministry of Transport will also be represented by Lieut.-Colonel Mount; the chief engineers will be Mr. Newlands, of the London, Midland and Scottish, and Mr. E. A. Wilson, of the Metropolitan; the mechanical engineers will be Mr. Collett and Mr. Gresley; the signal engineer will be Lieut.-Colonel Hall, assistant engineer, signals and telegraphs, Southern Railway; the operating officer is Mr. Cox, of the Southern; whilst the National Union of Railwaymen will be represented by Mr. H. C. Charleton—an old driver—and the secretary is Mr. C. Tilden Smith, of the Railway Inspection Department, who was the secretary of the previous Committee. That Committee was appointed in October, 1920; its report was issued on June 21st, 1922, and was reviewed in THE ENGINEER of June 30th, 1922. The Committee then reported that automatic train control presented the only reliable method of preventing drivers over-running signals; that a case for its installation had been made out, and that a committee of experts should immediately be formed to determine and standardise track and locomotive apparatus.

Notes and Memoranda.

THE cost to date of the Welland Ship Canal has been about 90,000,000 dollars, and it is 78 per cent. complete.

THE world's production of salt in 1926 amounted to about 28 million tons as compared with about 19 million tons in 1913.

ACCORDING to Mr. Harold Moore, petrol which has escaped from a tanker and has floated a distance of from 10 to 13 miles, has become quite safe.

THE Tempest shaft of Lord Londonderry's new colliery at Seaham Harbour has been completed to a depth of 352 fathoms. The work of sinking has occupied four years

EXPERIMENTS are being carried out by the Imperial Institute off the end of Southend Pier to determine the relative merits of Manilla and East African sisal for rope-making. It is reported that the sisal has already proved superior, but the experiments are being continued.

WHAT is claimed to be one of the largest gold dredgers has been put to work on the river Lena, Siberia. It is electrically driven and is capable of dredging to a depth of 80ft., while the tailings are discharged at a radius of 176ft. The motors on board have a combined output of 1335 horse-power.

A DISCOVERY, which may save an enormous amount of money, has, according to the *Daily Telegraph*, been made by a Danish manufacturer. It is described as a wood-oil for killing dry-rot, and the experiments which have been made are said to have proved successful. The "wood-oil," the composition of which is the inventor's secret, renders wood fireproof.

IT appears from the official report that the cause of the disastrous explosion of a gasholder in Pittsburg, which occurred on November 14th last, was a leaky valve. The holder had been partly raised by blowing air into it, and the leaky valve allowed gas also to enter. The resulting explosive mixture was ignited by a welding blow-pipe which was being used on the outside of the bell.

THE outstanding properties of chromium plate are its great hardness, in which it is possible for it to exceed that of glass and hardened steel, its resistance to tarnish and its inertness to chemicals which readily attack other metal coatings. It has been claimed that, in addition, it is capable of efficiently protecting the underlying base metal from corrosion, but this has been disputed. In a paper, which discusses this important matter, read before the Electroplaters' and Depositors' Technical Society by Mr. Leslie Wright, it is definitely stated that chromium does not act as a corrosion preventive.

THE twentieth year of activity for the "Isherwood" system marks an epoch in ship construction development, inasmuch as last year's return shows still more remarkable progress in the adoption of the "Bracketless system"—which is really an "improved Isherwood system"—than the year 1926, actually the year of its introduction. At the end of 1926 there were built and contracted for on the new system, fourteen vessels aggregating 180,000 tons deadweight carrying capacity, which at the close of 1927 increased to forty-one vessels, representing 412,000 tons deadweight, and with the ships placed on the pure "Isherwood" system, a total of sixty-seven vessels have been contracted for in the year.

ON January 13th a number of scientists witnessed at Schenectady a demonstration of an improved form of television. On the receiving machine was a small plate, which became luminous, and then a face of a man manipulating a machine at an electrical works, 3 miles away, became visible. He was smoking a cigar, and the smoke was seen ascending. His remarks were also distinctly heard. A young woman's face then appeared. She was playing a mandoline, the notes of which were clearly audible. When she showed a book, its illustrations were plainly visible. The apparatus employed is said to be not yet ready to be put on the market, but it is stated to be an advance on anything so far discovered.

IN the course of a paper on "The Utilisation of Town Refuse and Other Refuse Fuels," presented by Mr. Arthur B. Scorer at a recent meeting of the Institute of Fuel, the author remarked that there was a great deal of very small dust fuel, especially in the South Wales area, which was extremely hard to burn, as it ran like sand through an ordinary grate; at the same time it lay so close that, without forced draught it was impossible to get any air through it. A special bar for burning this fuel consisted of one with horizontal air spaces in place of the ordinary vertical air spaces. This enabled anthracite duff, in the proportion of half duff to half of a larger grade, to be burned in a Meldrum forced draught furnace.

IN the course of a paper on the extrusion process, which he read before the Cleveland Institution of Engineers, Mr. J. E. Newson said that light aluminium alloys were characterised by a rather high coefficient of friction when hot, and high resistance to shear, making them difficult to extrude with low pressures, in addition to which they had a limited working range, and in some cases, such as Y alloy, they retained a large proportion of their strength at elevated temperatures. Their high coefficient of friction rendered them very liable to score, and it was remarkable that this feature was very pronounced in the high-strength brasses, where it was found in practice, that the higher the aluminium content the greater the ease with which scoring occurred.

JUST before Christmas Day the toe of a cofferdam being used in connection with the Hudson Bridge, New Jersey, failed and caused the drowning of three men. It appears from an account of the accident given in the *Engineering News-Record* that the structure consisted of a single line of sheeting, and that the excavation of the bottom had gone down 4ft., inside of a berm about 5ft. wide, which was left along the foot of the cofferdam wall. The sheet piles here were seated a foot or two in the bottom, so that the body of the excavation was 2ft. or 3ft. below the pile points. The lowest tier of bracing was 6ft. or 8ft. above. Without warning, the lower ends of the piles in this part of the wall were forced in by the water and soil pressure outside, apparently shearing off the material of the berm and admitting a large rush of mud and water.

Miscellanea.

A RADIO station, with a capacity of 5 kilowatts, is to be installed at Winnipeg, Manitoba.

THE Craven and Wyken Collieries, near Coventry, are to be closed on account of the ingress of water.

THE old coal staithes at Dunster-on-Tyne are to be renovated after having been in service since 1892.

A NEW pier for ocean-going vessels is to be built on the North Shore of Vancouver Harbour at a cost of 150,000 dollars.

A LOW-TEMPERATURE coal carbonisation plant is to be put up at Askern, near Doncaster. It is to have a capacity of 3000 tons of coal a week.

THE No. 3 blast-furnace of the Algoma Steel Corporation, Ontario, has been blown in and the 12in. merchant mill is working double shift.

AN electric power plant, which is to cost about £1,000,000, and will serve an area of 10,000 square miles, is to be constructed at Estevan, Saskatchewan.

A NUMBER of telephone subscribers in Shanghai who are on the central exchange on the manual system will be transferred to a new automatic exchange of the latest design early this year.

THE third of the new 5000 kilowatt gas engines of the Staveley Coal and Iron Company has now been given its trial runs. A description of the plant appeared in THE ENGINEER of November 18th last.

THE Government of Mysore has in view schemes for the generation of electric power on a large scale at the Gersoppa Falls and at the Mekadatu Falls of the Cauvery River below the Sivasamudram Falls.

THE Royalite No. 4 oil well in the Turner Valley of Alberta is producing at an average rate of over 600 barrels a day, while the total production of the local wells is at the rate of some 23,500 barrels a month.

ARRANGEMENTS are being made by the Victorian State Rivers and Water Supply Commission to begin the construction of the Eppalock reservoir on the Campaspe River; an important tributary of the Murray River.

ACCORDING to Hon. James Lyon, former Minister of Lands and Forests in Ontario, there is prospect of the early expansion of the iron and steel industry at Sault Ste. Marie, Ontario, to include the development of millions of tons of low grade iron ore which, up to date, has never been exploited.

IT is reported from Belgrade that the Albanian Government has concluded a contract with an Italian group for a credit of 8,000,000 gold francs—£330,000—for the construction of a harbour at the port of Durazzo. By the terms of the agreement, all ships flying the Italian flag will, it is stated, be exempted from the payment of harbour dues.

A WIRELESS telephone service between Berlin and New York, *vid* London, will, it is stated, be opened shortly, the experiments made having proved satisfactory, and the negotiations with the authorities concerned having been successful. A three minutes' call will cost £16. It is further announced that a telephone service between Berlin and Buenos Aires will be opened in the spring.

THE new bridge over the White Nile at Khartoum was opened on the 16th inst. The bridge measures 2012ft. and has a 30ft. roadway and a sloping approach of 820ft. on the Khartoum side and 634ft. on the Omdurman side. There are eight spans, including the swing span of 304ft. The bridge carries a tramway. The British contractors are the English Electric Company, Messrs. Dorman, Long and Co., and Callender's Cable and Construction Company.

THE Montreal and Western Canada Company, representing important Montreal financial interests, has applied to the Canadian Government for legislation authorising it to develop power from the rapids of the St. Lawrence, between Cornwall and Montreal. The project involves the construction of a 30ft. waterway between those points. It will include (*a*) a deep waterway from Montreal Harbour to Laprairie Basin; (*b*) a canal from the basin to Caughnawaga; (*c*) a waterway through Lake St. Louis to Melocheville; (*d*) another canal from that point to Hungry Bay; and (*e*) a 30ft. waterway through Lake St. Francis to Cornwall. An unsuccessful attempt was made during the last session of Parliament to secure the adoption of a Bill for a similar project.

UNDER the auspices of the Upper Liao River Conservancy Board the firm of McDonnell and Gorman, of Tientain, is executing a conservancy project for the improvement of the Liao River. The contract amounts to 1,277,500 dollars, and the work is being done according to plans prepared by Dr. B. Okazaki, Engineer-in-Chief of the Board, who, with the Japanese engineering staff, is supervising the work. The purpose of the scheme is the reversion into the Liao River of some of the water at present finding its way to the sea through the Shwangtaitze River. This latter river had its beginning as a narrow ditch dug for the purpose of smuggling salt, and has, within a comparatively short number of years, become a sizable stream, so large that the water lost to the Liao River is of considerable importance.

ELEVEN wireless stations are operating in North and South Manchuria, including Mukden, Newchwang, Changchun, Harbin, Kirin City, Tsitsihar, Manchuli, Yenchi, Suifengho, Fuching, and Heiho. The stations are able to communicate with Europe. A pact for communicating with Germany was recently signed, and another with France is being negotiated. The total cost of constructing the stations is estimated at 1,300,000 dollars, besides another 400,000 dollars for training students. A wireless telegraphy school in Mukden has over ninety students, divided into engineering and intelligence departments. The entrance requirement is senior middle school graduation. The course for engineering is four years, and for intelligence two years. The Japanese have also established wireless stations at Dairen, Liushutun, and Shahokow, and exchange messages with the Chinese stations in Manchuria. A broadcasting station was recently organised in Mukden by both officials and merchants.

SOME EARLY LOCOMOTIVES OF THE BALTIMORE AND OHIO RAILROAD

(For description see page 64)

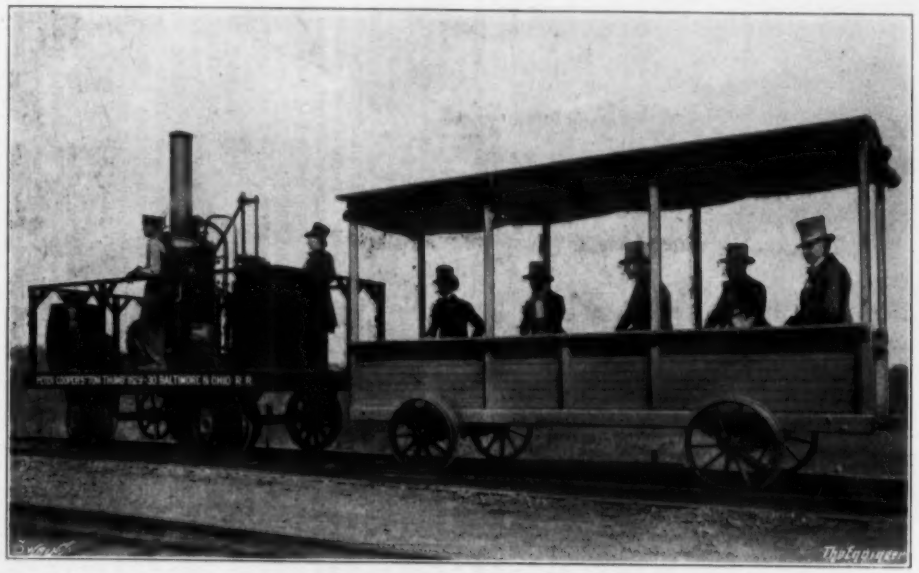


FIG. 7—THE "TOM THUMB," 1829

FIG. 8—THE "YORK," 1831

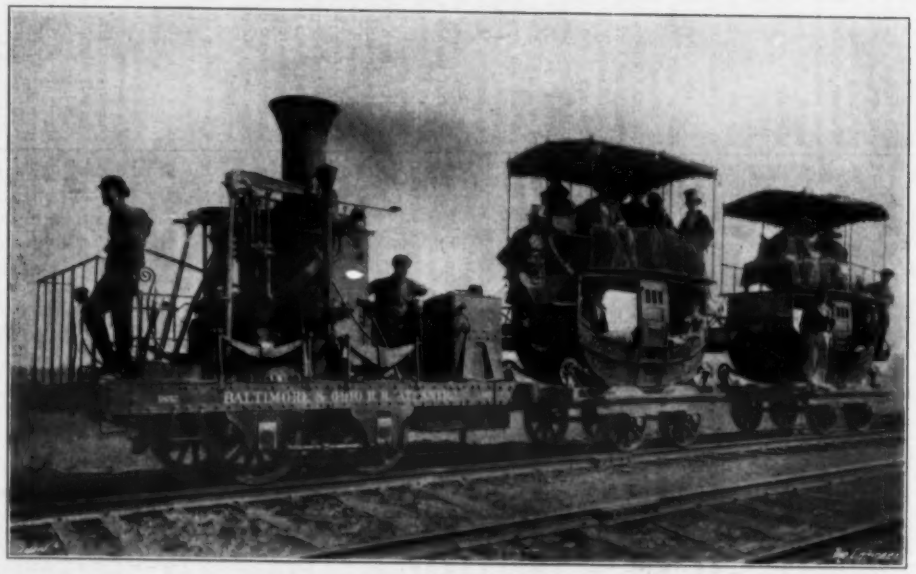


FIG. 9—THE "ATLANTIC," 1832

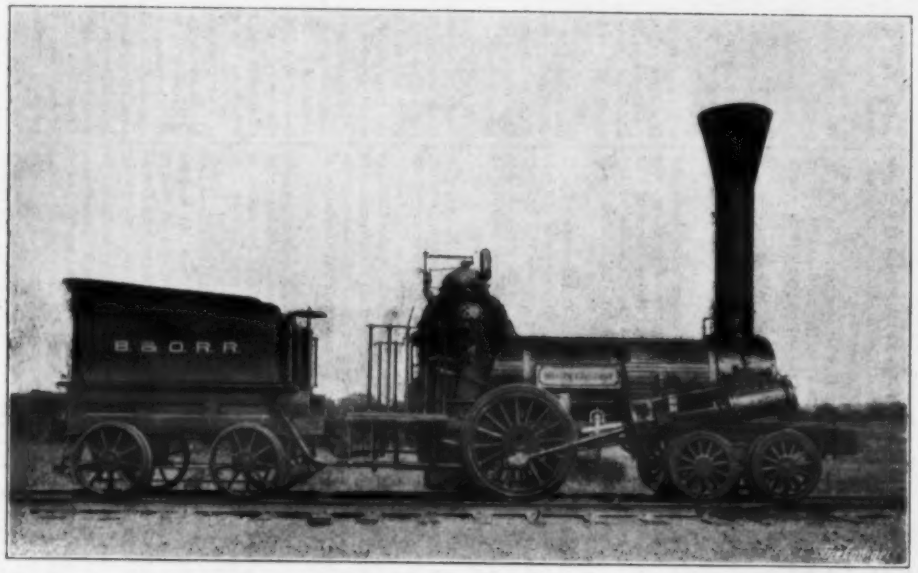


FIG. 10—THE "LAFAYETTE," LATER THE "WILLIAM GALLOWAY," 1837

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THE ENGINEER.

JANUARY 20, 1928.

The Commercial Evolution of Engineering.

To a man who possesses the essential qualifications of an engineer, technical matters will always be of more interest than questions of buying or selling. Great, however, as may be the intellectual pleasure he derives from his profession and the pride he feels in a technical success, these feelings must never obscure the fact that the making of profits is quite as important as the production of machines. Such a statement should not be regarded either as sordid or shocking, for the fact is undeniable that unless an industry is remunerative, it will soon cease to exist; and with it will disappear all the field for even the most beautiful applications of scientific knowledge. The basis on which engineering rests is indeed as much commercial as technical. This double aspect is well realised by the men responsible for the conduct of manufacturing establishments. Whether it is sufficiently appreciated by those who hope to promote engineering progress by their intellectual or educational activity alone is not so certain. To them, such progress is too often represented by the acquisition of a more exact knowledge of phenomena, the generalisation of such knowledge in the form of theories, and its utilisation in the improvement of design. The immense number of books on engineering matters which are published every year show how widespread is the belief that the evolution of engineering is little or nothing more than the perfecting of theories and apparatus. The other side of the picture, however, deserves attention. If engineering is based equally on a commercial and on a technical foundation, there is a commercial evolution to consider as well as a technical one. The former is not simply a question of increasing sales any more than the latter consists in simply building bigger machines. Both are the expression of a fundamental progress urged upon firms by the struggle for existence. The difference between the two kinds of evolution is, however, as great as the difference between the forces which bring them about. Technical evolution is distinctly individualistic, while commercial evolution, without having any nature of altruism, is, nevertheless, not free from the socialistic idea of avoiding competition. Technically, a firm strives to perfect old and to create new designs, to gain an advantage over its competitors. Experiments are tried and developments undertaken primarily for the benefit of those who make them. Their rivals, in their turn, are spurred on to make further advances, and from this continual struggle for supremacy does progress result.

Since, however, supremacy in design or technique almost invariably goes hand in hand with supremacy in the markets, the struggle has a definitely commercial aspect. Now the purely commercial man has no care for technical progress as such. He sees that experiments and developments cost money, and he would be glad to leave the expense and risk to others, were it not shown by experience that this course always leads in the end to the decline and fall of a business. Anxious not to be ruined by either policy, and seeing a further possibility of disaster in reckless competition for orders, he casts about for means to secure himself, and so are born the whole series of cartels, rings, trusts, combinations, unions, associations, and "gentleman's agreements" which figure so largely in modern industry. Whether these are good or bad for a trade or a nation, whether they are wise and benignant regulators of industry or soulless and avaricious exploiters of the public, or whether they represent a passing or permanent feature of commercial life, are questions to which prejudice finds a readier answer than knowledge. For good or evil, they are in active existence to-day, and their extension seems to be the outstanding phenomenon of the commercial evolution of the present time. We have indicated some of the causes which have led to their creation. They are all directed to the elimination or mitigation of competition, and as such they are objects of suspicion to all who benefit by competition. When a single company can obtain the monopoly of the production of some raw material or article, it disposes of competition in the simplest manner. The consumer is only benefited by the monopoly if unified control results in such an efficiency of production and distribution that the cost of the product is actually lower to him than it would be under competitive conditions. That this is so is always the claim of monopolists, but the consumer has to be convinced first that greater efficiency does really exist, and, secondly, that he derives any benefit from it by reduction in price. It is possible that a monopoly may be to the advantage of the consumer as well as the producer, though no monopoly was ever created with the object of reducing prices. Monopolies, however, are not possible in the majority of cases, and this is perhaps a good thing. There is, nevertheless, at least one word to be said in their favour, namely, that there is no secrecy about either their existence or their methods. Even though the consumer may smile at the statement that he is benefited by the elimination of wasteful competition, he, at any rate, is not irritated by the belief that he is at the mercy of some secret combination. This is an important psychological factor. Furthermore, his patriotism may cause him to take a sort of pride in the existence of a huge monopolistic company of his own nationality, while he will never be proud of a ring. Apart from obtaining monopolies, the simplest means by which manufacturers have sought to maintain prices at a remunerative level is for a number of the most important firms in any industry merely to agree to quote only in accordance with an agreed price schedule. No greater efficiency of production or distribution, and, indeed, no economic benefit of any kind, can arise from such an agreement. Every firm continues to make the full line of its products, to maintain its existing organisation and methods, and, in fact, to conduct its business no more efficiently than before. The buyer, therefore, either pays a price dictated by the production costs of the least efficient firm, or, exasperated by receiving identical quotations from a number of firms, some of which could obviously produce the article demanded more cheaply than others, he refuses to submit to an apparent exploitation, and places his order abroad. The damage that this system of price rings can do to the industries in which it exists may be gathered from the recent remark of a foreign manufacturer that it was one of his great assets. A modification of the simple price ring, which is believed to have found considerable favour among certain manufacturers, is for the firms in the ring to compare their respective estimates beforehand. It is then agreed that the firm which can produce most cheaply shall be allowed to obtain the order, but at an enhanced price, the difference being shared

by the members of the ring. This kind of business, although it hardly tends to promote any greater efficiency of production, may possibly permit of a lower price to the consumer than he would be quoted under the previous system. An even better method, to which it would appear that German manufacturers are inclined, is for an agreement to be made under which each confines himself to a limited range of products, and leaves the rest to the others. This has the effect of allowing each firm to specialise in the products which it can manufacture most advantageously by reason of its particular experience or equipment instead of dispersing its energies over a great variety of articles. Moreover, having the market for its specialities more or less to itself, it can maintain prices at a remunerative level. Under this system the consumer may certainly benefit, for the concentration of the makers each on the production of a few types of machines, and the larger quantities in which these types can be manufactured, both tend materially to lessen the costs of production. Each firm may maintain complete independence, with no restriction whatever on its activities, except the agreement not to manufacture the products allotted to other firms in the group. Or, on the other hand, the association may be closer, capital may be interchanged, profits may be pooled, or other methods be adopted to take away the risks involved in neglecting certain profitable lines of manufacture. There is, moreover, no particular need for secrecy in any such arrangement. Carried out to its full extent, it would reduce trade to a number of small monopolies, obtained by agreement rather than by the ruin of competitors. Whether it would be the best form for commercial evolution to take is a question for students of social economy.

Experience seems to show that some organisation of trade is necessary to prevent competition so intense as to be injurious to everybody, and common sense indicates that an intelligent organisation might at the same time reduce the price to the consumer while permitting satisfactory returns to the producer. In any case, there is no need for secrecy in the matter. All arrangements that cannot be avowed are of necessity suspect. The experiments which are being made with a view to progress in the domain of commerce should be open for discussion as freely as the developments in manufacturing. If an agreement is in accordance with the ethics of business, there is no reason why it should not be openly proclaimed, whereas if it is not, the more widely it is known the better. Many different paths may be tried before the true road of commercial evolution is clear, but the more light there is available the sooner will the true road be found.

The Continental Coal Situation.

AN important factor in the coal situation is the rapid development of the continental colliery industry, whereby countries which were formerly consumers of British coal are now, in some cases, producing most of what they require and in others have succeeded in restricting their needs to the extent that they are now taking much smaller quantities of foreign fuel. At one time the greater part of the Continent was an almost exclusive market for British coal. There was no incentive to risk the working of seams of inferior coal under unfavourable conditions when abundant supplies of cheap fuel were procurable from Great Britain. For the first time the danger of relying upon foreign coal was brought home to some consumers by the war, and, again, on the termination of hostilities, the dearth of coal on the Continent was so great that British coalowners could not meet the demand. There was an inevitable inflation of prices which caused grievances and discontent. Then began an inquiry into the best means of reducing the annual expenditure upon imported solid and liquid fuels, alike by economising consumption and by making the best use of hydro-carbons produced at home. Notable progress has already been made in this direction, particularly by the utilisation of the enormous reserves of hydraulic energy that exist in many parts of the Continent. The programme would have developed more or less normally without disturbing the situation of the British coal trade to the extent it has done, if it were not for the miners' strike which, during seven months, deprived the Continent of its main source of coal supply. A catastrophe of such magnitude called for urgent measures of defence. Every effort was made to develop the continental coal resources. In France the monthly increases were watched with interest in the hope that the total would reach a figure that, with other supplies of native fuel, would render the country practically independent of foreign coal. Germany increased her coal production, and in Poland the output grew so considerably that the lack of cheap transport facilities alone prevents that country from taking a commanding position in Western European markets. On the termination of the miners' strike, the Continent had increased its coal production by 30 million tons, representing exactly the amount of the shortage of coal supplies from Great Britain. For the first time the Continent became independent of British coal.

This growth of the continental colliery industry took place at a time when there was a diminishing consumption, partly through a more economical use of fuels and partly through the industrial depression. The increased production cannot be absorbed. There are huge stocks in France, Belgium and Germany, and each country aims at supplying its own needs by facilitating and cheapening transport, by preferential rates, and, in some cases, by increasing import duties on coal. It is only by these means that foreign coal can compete in continental markets with the British. In a general way, the increased production on the Continent has only been obtained by the working of inferior coal seams. Most of the coal cannot be transported without considerable loss in the form of slack. Therefore the collieries in the North of France, which have been reconstructed with the most modern plants, utilise the dust for the manufacture of patent fuels, and the increasing use of pulverised coal for steam generating plants has given a value to the enormous quantities of slack that formerly encumbered the pits. Means have been found of burning the hard coal of Anzin and elsewhere, in the place of imported anthracite. As the northern coalfields are inconveniently situated for cheap transport to consuming centres, many of the collieries are equipped with laboratories for experimenting with processes for the treatment of coal. Béthune claims to be capable of producing industrially ethyl alcohol and other by-products from coke oven gases. The future of the northern coalfields depends so much upon the commercial treatment of coal for the production of by-products of value, that chemistry has become an increasingly important factor in the colliery industry. Little attention is paid to the low-temperature carbonisation of coal, on account of the cost, but a considerable amount of experimental work continues to be carried out with catalytic processes. So far as coal getting is concerned, the French colliery companies employ imported workmen, mostly Poles, who have settled down in the country, and whose daily output is only inferior to that of the British and Germans. Coal-cutting machines are used wherever possible. While the continental production has increased, there is, all around, a lessened consumption, partly owing to the more economical use of fuel for domestic purposes, one feature of which is the replacing of anthracite stoves by special stoves for burning wood, and partly through the growing employment of oil fuel. Every use is made of lignite and other inferior products. The various commissions and other bodies which are carrying out experimental and propaganda work for the utilisation of native fuels are showing positive results in the way of producing new fuels, and employing them in the most economical way possible. Progress in this direction is perhaps not so great as had been expected, but it appears to be continuous, and the solution of the fuel problem is likely to be worked out progressively in course of time. Meanwhile, the great problem is the national electrification scheme, which provides for the production of electrical energy in the coalfields in conjunction with sources of hydraulic supply. Throughout the northern coalfields there are already electrical power plants for distribution over large areas, and, in course of time, other more powerful installations will be coupled up with hydro-electric plants in the Alps, the Massif Central, and elsewhere in order to create an interdependence ensuring an absolutely regular and reliable supply.

These changed conditions on the Continent have necessarily modified entirely the outlook for the British coal trade. British coalowners have no longer any market of which they can claim a monopoly. In Spain it is intended to carry out a vast electrification scheme in the hope of rendering the country partly independent of foreign coal supplies. Italy has endeavoured to find a means of facilitating and cheapening the transport of coal from Poland. With regard to producing countries, France possesses such heavy stocks of coal that colliery proprietors are hoping to secure a large increase in the import duties on fuel, although the whole body of consumers is up in arms against them. Consumers complain that prices are too high, and coalowners affirm that the cost of production is increasing. In Belgium the situation is desperate. Coalowners in that country cannot compete with German fuel, and much larger quantities of foreign coal are going into the country than before the war, even from Poland, which has succeeded in securing orders from the railways. In no branch has competition become so keen as in the coal industry. It must continue while the industrial depression remains acute, and even with a revival there can be no return to former conditions unless the poorer coalfields succumb to the competition. If British coalowners have lost their monopoly, it does not mean that they have lost their markets, and in many cases they are holding their own, although at the cost of low prices that imply meagre profits. They are reported even to have secured an order in Luxemburg in competition with German coal. British coalowners have the advantage of supplying a superior quality coal and of enjoying low sea freights which should enable them to compete with continental collieries, unless fiscal charges, such as those now proposed in France, eliminate all chance of making a profit. After all, each country has to consider, first, the interests of the great body of consumers, and as cheap coal is the basis of industrial prosperity, it is hardly likely that an exaggerated protection of the continental coal industry will be allowed to interfere with normal competition. British coalowners may increase their trade by underselling foreign competitors, and they will certainly enjoy a preference on account of the quality of British coal, but the trade can only be recovered by a clear understanding of the situation by British miners, who must see that coal mining has now become a highly competitive industry.

The Use of Diesel Engines for Peak Load Supply.

(By a Correspondent.)

IN the Electricity (Supply) Act, 1926, Clause 14, headed "Power to Close Generating Stations in certain events," it is laid down that "when the Central Electricity Board are in a position to supply directly or indirectly to those undertakers such quantity of electricity as the undertakers would require for the purposes of their undertakirgs if the station were closed, and undertake to give such a supply for a period of not less than seven years on specified terms ascertained in accordance with the provisions of this Act, and are satisfied the cost of the supply on those terms is below the then prevailing cost to those undertakers of generating electricity at the station, and those undertakers refuse, or within three months after such notification fail to agree, to take such a supply directly or indirectly from the Board, then, if the Electricity Commissioners are satisfied as respects the next subsequent year the cost of production of electricity generated by those undertakers at the station substantially exceeded the cost they would have incurred had they purchased the like quantity of electricity directly or indirectly from the Board on the specified terms ascertained as aforesaid, the Electricity Commissioners may, if in their opinion it is expedient that the station should cease to be used as a generating station, by order require the authorised undertakers within such time as the Electricity Commissioners may allow (not being less than six months from the date of the order), to take a supply of electricity in bulk from the Board, and shut down the generating station as such."

In the Supplementary Particulars issued by the Electricity Commission under the South-Eastern Electricity Scheme, 1927, Table VI. gives the dates at which it is estimated that the various stations now generating electricity are to be shut down, exclusive of the one or two stations which are to be selected and kept running under the scheme.

The scheme contemplates the erection of Base Load Stations and provision of certain stations to run two shifts and certain others which are to be peak load stations. No figures are given as to the actual cost of production in these peak load stations, but they are in every case steam turbine-driven stations, and it is understood that the official estimate is that the consumption of coal per unit in these peak load stations will be of the order of 7½ lb. to 8 lb. per unit, which at the estimated price of coal will mean a cost for fuel alone of about ·8d. per unit generated.

In the area covered by the Order there are many stations using heavy oil engines, the cost per unit for fuel in all of which is from about ·34d. to ·4d. per unit, or roughly half the fuel cost of the proposed steam peak load stations.

The writer accepts the assurance that when the time comes for a change-over, the Board will deal fairly with each individual station, and will consider

carefully the actual cost at which it is then generating, and will not ask for it to be shut down unless it can be proved that the whole of its load can be more economically supplied off the "grid," but at the present time the Electricity Commisisoners are only granting a 10-year loan period for heavy oil engines, now being erected, on the ground that they will be shut down in a few years' time.

Now, whilst undoubtedly the large steam turbine station running on a good load factor can generate current at a lower "all in" price than an oil engine station, the steam station on a poor load factor, as, for example, a peak load station, is very uneconomical, and cannot generate "peak load" units as cheaply as an oil engine station. Why not, when possible, take advantage of the best points of both prime movers?

In the Supplementary Particulars issued by the Central Board, it will be found that West Ham Station, which is equipped with steam turbines, is apparently to be used as a peak load station, and the following figures can be extracted:—

Year.	Units, millions.	Max. demand. kW.	Cost. £	Load factor. %	Cost per unit d.
1928–29	9·6	39,500	62,514	2·78	1·57
1929–30	15·8	40,000	142,416	4·52	2·16
1930–31	8·02	40,000	133,979	2·29	4·00
1931–32	7·30	35,000	131,704	2·38	4·32
1932–33	6·10	40,000	131,995	1·74	5·18
1933–34	5·60	41,500	131,986	1·54	5·67

It will be seen that in 1934 it is credited with a maximum demand of 41,500 kW, 5·6 million units generated, a load factor of 1·54 per cent., and the cost to the Central Board is put at £131,986, or 5·67d. per unit.

Any steam station used merely for peak load must be uneconomical and wasteful of the national supply of fuel. In addition, if the peak load, as well as the basic load has to be taken on the "grid," the main and subsidiary transmission lines, the step-up and step-down transformers and all the switchgear have to be much larger, and therefore much more costly, than if only the basic load were supplied, and the peak generated locally.

On the other hand, in the South-Eastern England Area there are at the present moment in the stations of authorised undertakers more than 30,000 kW of heavy oil engine plant, a very considerable portion of which could be used to take the peak load, thus reducing the kW charge to these stations, and relieving the Central Board of the extra cost of running the uneconomical steam plant and of providing mains and transformers large enough for the full peak load of the area.

The Reigate Corporation's station has at present Diesel engines of a capacity of 1570 kW, and is just putting in a new set of 1170 kW. Close to it is the Leatherhead Company's station, with a capacity of 1210 kW, with another 1000 kW set now being erected.

In years to come, when taking their basic load from the "grid," these two stations by running their oil engines could relieve the Central Board of nearly 5000 kW of peak load, thus reducing the transmission mains and transformers in their district by that amount and saving between them 5000 × (say) £3=£15,000 per annum of kilowatt charges, the only additional cost to the stations—as they have the plant already—being one shift of drivers for a few months in the year. Having only to run for a few hours per day and that only during the winter months, practically all the sets would be available, and the cost of repairs and upkeep would be very small indeed.

It is said that the proposed steam peak load stations, such as West Ham, are in existence, and therefore why not use them? The answer is that the oil engines are also in existence, can generate more cheaply, and, if used, will, as stated above, reduce the transmission losses. What reason can be put forward then for shutting down the existing oil engines?

The writer ventures to think that it will pay both the authorised undertaker and also the Central Board to allow the former to take his basic supply from the "grid" and still run his oil engines on the peak load, when the necessity for restricting the period of the loan for oil engines which have to be put down in the interim disappears, and insistence on it is merely penalising present consumers unnecessarily and retarding development of the outlying areas. It goes farther than that, because if it is generally realised that only a ten-year loan can be obtained then no new outlying oil stations will be put down at the present time.

The reliability of the heavy oil engine has been proved time and again at sea, where that type of engine is giving efficient service under more trying conditions than ever experienced on shore.

Engineers who are not familiar with heavy oil engines appear to be under the impression that their life is short. As one who now nearly twenty-five years ago put in the first Diesel engine in any electric light station in this country and has since then erected in different parts of the world fifteen or sixteen stations, including some fifty to sixty internal combustion engines, the writer can only say that the original Diesel engine, after being in use in the Hindhead Station for nearly twenty years, was sold during the war for use abroad at about its original cost, and as far as he knows is still at work. Further without exception every other Diesel engine which he has put in is still at work, so that if only a ten years' loan be granted it is obviously not based upon the physical life of the engine, nor is it, it is contended, warranted by the assumption that it will not pay to run oil engines once the supply is available from the "grid."

Apart from these considerations there are others which it is suggested should not be overlooked. It is well known that a heavy oil engine can be run up and put to work on the mains in from one to three minutes, and it would therefore be invaluable if, in the event of sudden fogs, the oil engine stations could be called on to take the oncoming load, thus relieving the steam peak load stations. Again, in the event which cannot be overlooked of a breakdown in the transmission lines the oil engines could provide current to carry on the essential service.

Although we all hope that some better method than war may be found in future for settling international disputes, no one would be bold enough to say that this country will never be engaged in war again, and, as was pointed out by the writer and his partner, Mr. Townend, in a paper* which was read before the Diesel Engine Users Association in May, 1924, in the event of an air raid in this country the enemy aircraft would only have to follow up the course of the rivers when it would be almost impossible for them to miss the large capital steam stations. The paper gave detailed estimates and particulars of an underground Diesel station which could be put down anywhere in the heart of a crowded city and be used for carrying the peak load, while owing to its giving no indication of its presence would almost certainly be unaffected by an air raid and could be relied upon to carry on essential services. Those who have had an opportunity recently of seeing the 1200-kW Diesel set made by the General Electric Company and installed in the underground station of the Charing Cross and Strand Company will appreciate the practicability of this suggestion.

The paper above referred to gave the cost of such an underground station complete for a capacity of 17,500 kW as £23 5s. per kilowatt installed, including land, buildings, and equipment complete, the cost of the 5000 B.H.P. sets then suggested being £13 10s. per kilowatt. One of the Berlin stations has recently installed two 11,700 B.H.P. engines merely to take over the peak load and serve as standby sets, notwithstaind the fact that in this particular station the brown coal used for the steam sets is obtainable at 2s. 6d. per ton, as against £6 per ton for fuel oil, the cost of these larger units having come down to some £10 to £12 per kilowatt complete. If, therefore, this can be done in Berlin when coal costs only 2s. 6d. per ton and fuel oil £6 per ton, it would appear to be worth considering here when coal costs 19s. and fuel oil £5.

Whilst the writer's immediate plea is for the continued use of existing oil engines, the general question of the use of steam turbines for the basic load for which they are eminently fitted and the use of oil engines for the peak load should not be overlooked. The oil engine costs only half as much for fuel for peak load units and less for labour, whilst it is very questionable whether, when new peak load stations have to be put up, their capital cost would be any less with steam turbines than with oil engines.

The writer has recently received tenders for Diesel alternators of 7500 kW capacity at £9 12s. per kilowatt delivered and erected complete, including piping, and has laid out a station containing three of these sets giving an aggregate installed capacity of 22,500 kW, the total capital cost of the complete station, including buildings, plant, switchgear, storage tanks, and all accessories working out just under £14 per kilowatt of installed capacity.

It will be appreciated that, if obstacles are to be put in the way of continued use of heavy oil engines in circumstances in which they could be used with advantage in this country, the capital invested by British manufacturers in the production of these engines and the skill and experience obtained will be wasted, as with their own home market practically lost they will be unable to compete on anything like level terms with the very skilled and active makers in Switzerland and Germany, who, with their own markets secured, will be able, every time, to undercut the British manufacturers when competing for heavy oil engines which will still be required in India and other British Dominions.

* "Electricity Supply in War Time, as affected by the Improvements in Internal Combustion Engines."

Obituary.

WILLIAM EDGAR LEA.

WE have received, with a request that they might be published, the following particulars of the career of the late Mr. William Edgar Lea, whose death took place at Prestatyn, in North Wales, on December 15th.

William Edgar Lea, who at the time of his death was in his seventy-ninth year, was the eldest son of the late Mr. Richard Lea, of Runcorn, where in 1849 he established the firm of Lea and Son. From the year 1872 the business was carried on by the subject of this memoir, who devoted his attention particularly to the engineering side of the undertaking.

W. E. Lea was a prolific inventor in many directions, especially in connection with the preparation and compression of gases—notably oxygen, hydrogen and nitrous acid. He carried out much experimental work in collaboration with the late Mr. Thomas Fletcher, of Warrington, and also with the late Mr. J. H. Parkinson, who was among the first to take out patents for processes for separating oxygen from the atmosphere with the aid of liquid air. On the death of Mr. Parkinson, Mr. Lea continued to experiment in oxygen manufacture, and ultimately erected and successfully operated on a commercial scale at Runcorn an extensive oxygen producing and compressing plant. For this plant he designed and constructed the whole of the necessary equipment, including the compressors and gas cylinders, and their valves, and with it he began to supply compressed gas in August, 1899. Since that time his firm has kept in the forefront as a producer and supplier of compressed oxygen, hydrogen and nitrous oxide gases of high purity. In view of his wide experience in the compression of gases, Mr. Lea was, during the war, chosen by the Government to carry out some of the early experiments in the manufacture of poison gases and their compression into cylinders, several leading chemists visiting his works for the purpose.

Mr. Lea did not, however, confine his activities to supplying gases. As early as the year 1874 he took out a patent for reciprocating hydraulic engines, and four years later another patent for a heating apparatus, following up his work in that direction by other inventions which were successfully applied. He early interested himself in the telephone, and in 1886 he took out a patent for a loud-speaking telephonic instrument and for special insulators for use in connection with it. Several of his loud-speaking instruments were employed at the Liverpool Exhibition of 1886 for transmitting music from bandstands in the grounds to the interiors of buildings.

The subject of locomotion had great attractions for him. He is reported to have been the first in the town of Runcorn to use, successively, the bone-shaker, the high bicycle, the safety bicycle, pneumatic tires and the motor car; and, finally, he was the first to own a self-propelled motor lorry. He also assisted the late Mr. D. Rudge in the design and manufacture of the early cycle which bore the latter's name, and was himself a leading cycle racer both on the road and on the track.

ROBERT PERCY SELLON.

WIDESPREAD regret, especially among those who were associated with the Anglo-American Brush Electric Light Corporation—afterwards the Brush Electrical Engineering Company, Ltd.—will be felt at the death of Mr. R. P. Sellon, which took place at his home, Albury Edge, Merstham, Surrey, on the 11th inst.

Robert Percy Sellon, who was the son of the late Colonel Robert Sellon Sellon, R.E., was born in 1863. He was educated at Bradfield College and received his technical training at the City and Guilds of London Technical College, Finsbury. He became connected with the Brush Company at an early period of his career, when the works were in Belvedere-road, Lambeth, before they were moved to Loughborough, in Leicestershire, and eventually became managing director, a position which he held for many years.

Mr. Sellon was, in addition, a director of the County of London Electric Supply Company, Ltd.; of the Bournemouth and Poole Electricity Supply Company, Ltd.; of the Richmond Electric Light and Power Company, Ltd.; and of Johnson, Matthey and Co., Ltd. He was also a director of the Otis Elevator Company, Ltd.—the London branch of the Otis Elevator Company, of New York—which was afterwards amalgamated with R. Waygood and Co., Ltd., of Fetter-lane, London, E.C. 4, and retained a seat on the board of the company under its new name—Waygood-Otis, Ltd.

JOHN HARPER.

THE death of Mr. John Harper, the chairman of Harpers Ltd., of Aberdeen, is announced as having taken place at Bournemouth.

Mr. Harper was the elder son of the late Mr. John Harper, of Seafield. Early in his career he became associated with the firm of Harper and Co., which eventually was registered as Harpers Ltd. and had works in two other places in Aberdeen before being finally settled at Craiginches. Under Mr. Harper's supervision, the activities of the firm were extended in many directions, and he himself came to be regarded as an expert in the matter of the transmission of power and the mechanical propulsion of vehicles on roads. He was, in fact, among the first in the North to take up motoring, and was instrumental in the introduction of electric vehicles for private use.

THE River Weir Commissioners have decided to spend £18,580 on electrical equipment at the Hendon and Hudson Docks, and from £1500 to £3000 in removing the invert at the Hendon Dock junction gateway. They have also decided to lengthen the Hendon Dock foreshore breakwater at an estimated cost of £5000.

SCHMIDT-HENSCHEL LOCOMOTIVE—TABULATED RESULTS OF ROAD TESTS

Test number.	Date.	Test Train. Train number.	Number of axles.	Total weight.	Train section.		Average cut-off.	Total Running Time. Distance.	Time.	Average speed.	Average draw-bar pull.	Average draw-bar horse-power.	Mean gradient.	H.P. absorbed owing to gradient.	Total draw-bar H.P. based on the level.	Running Time Under Steam. Distance.	Time.	Average speed.	Average draw-bar pull.	Average draw-bar horse-power.	Mean gradient.	+ or — H.P. equivalent to resistance on gradient.	Total draw-bar H.P. based on the level.
				Tons			%	Miles.	Min.	M.p.h.	Lb.	H.P.		H.P.	H.P.	Miles.	Min.	M.p.h.	Lb.	H.P.		H.P.	H.P.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	3.3.27	3,008	47	454	Wp–Mg.		27	69·6	83·2	50·2	5,697	762·5	1 in 625	6·71	769·2	68·2	80·6	50·8	5,816	787·1	1 in 588	+ 6·90	794·0
2	5.3.27	Sdpl.	63	640	Wp–Cn.		38	100·7	122·0	49·5	7,822	1,031·7	1 in 370	10·95	1,042·6	97·0	114·6	50·8	8,113	1,097·8	1 in 367	+11·64	1,109·4
3	8.3.27	Sdpl.	51	507	Wp–Cn.		30	100·7	121·0	49·9	6,045	803·9	1 in 370	11·05	814·9	98·0	116·1	50·7	6,217	838·4	1 in 367	+11·54	849·9
4	8.3.27	Pb. 43	51	507	Cn–Wp.		24	100·7	130·0	46·4	4,590	570·1	1 in 370	10·26	559·8	98·7	125·5	47·3	4,683	592·8	1 in 367	−10·85	581·9
5	10.3.27	Pb. 42	47	463	Wp–Cn.		26	100·7	119·0	50·7	5,247	710·2	1 in 370	11·24	721·4	97·6	112·8	52·0	5,412	749·6	1 in 367	+11·84	761·4
6	10.3.27	Pb. 43	47	463	Cn–Wp.		20	100·7	131·5	45·9	3,913	480·3	1 in 370	11·15	469·15	98·3	128·0	46·1	4,056	493·2	1 in 367	−10·55	482·6
7	12.3.27	Pb. 42	67	672	Wp–Cn.		38	100·7	117·0	51·6	7,099	979·4	1 in 370	11·44	990·8	96·5	108·2	53·6	7,408	1,057·4	1 in 367	+12·23	1,069·6
8	12.3.27	Pb. 43	67	672	Cn–Wp.		32	100·7	120·5	50·1	6,294	843·3	1 in 370	11·15	832·1	97·8	116·0	50·6	6,482	876·9	1 in 367	−11·54	865·4
9	26.3.27	Pb. 42	67	760	Wp–Cn.		44	100·7	121·5	49·7	9,381	1,243·8	1 in 370	11·05	1,254·8	96·6	114·1	50·8	9,777	1,324·7	1 in 367	+11·64	1,336·3

TABULATED RESULTS (*continued*)

Test number.	Average Steam Pressures. Water-tube boiler. Section. 1.	2.	3.	4.	5.	6.	Average of 6 sections.	High pressure. Boiler.	Steam chest.	Low pressure. Boiler.	Steam chest.	Blast pipe.	Average Vacuum. Smoke-box.	Fire-box.	Ashpan.		Average Temperatures. Smoke-box. Middle.	Rear, top.	Rear, bottom.	H.P. cylinder. Admission.	Exhaust.	L.P. steam from superheater.	L.P. cylinder. Admission.	Exhaust.	Fire-box clothing. Top.	Sides.	Feed water. Inlet.	Outlet.	Air temperature.
	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	In. water.	In. water.	In. water.		Deg. Fah.	Deg. Fah.	Deg. Fah.	Deg. Fah.	Deg. Fah.	Deg. Fah.	Deg. Fah.	Deg. Fah.	Deg. Fah.	Deg. Fah.	Deg. Fah.	Deg. Fah.	Deg. Fah.
1	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53
1	1,029	1,118	1,118	1,279	1,176	1,096	1,135	799	753	150	144	1·62	2·48	1·02	·236		574	577	653	680	385	644	514	216	190	189	63	196	55
2	956	1,044	1,059	1,279	1,176	1,059	1,096	703	651	154	143	3·68	4·57	1·69	·236		601	651	689	722	417	657	547	223	189	201	59	190	50
3	971	1,074	1,103	1,309	1,191	1,088	1,122	734	700	151	141	2·21	3·58	0·905	·158		556	617	649	686	385	622	507	214	187	192	55	201	54
4	985	1,074	1,118	1,309	1,103	1,015	1,100	773	728	151	141	1·47	2·28	0·945	·118		545	594	617	649	372	608	482	212	196	196	55	190	54
5	956	1,074	1,088	1,294	1,147	1,029	1,097	784	710	151	141	1·62	2·24	0·71	·158		561	617	633	669	374	624	504	210	187	198	55	196	54
6	985	1,059	1,118	1,324	1,132	1,000	1,103	796	754	151	141	1·03	1·615	0·433	·078		509	590	612	637	374	601	468	210	192	214	57	187	59
7	953	1,066	1,093	1,368	1,203	1,076	1,126	688	637	150	138	3·38	4·06	1·26	·236		610	680	690	716	410	651	540	221	189	212	54	194	50
8	1,025	1,129	1,162	1,485	1,306	1,159	1,212	766	728	154	149	2·35	3·23	1·14	·158		604	653	673	702	392	651	522	216	190	207	55	172	59
9	1,000	1,132	1,132	1,529	1,294	1,074	1,193	681	634	157	146	4·71	4·55	2·127	·433		649	705	720	(748)	457	682	570	244	239	167	57	201	50

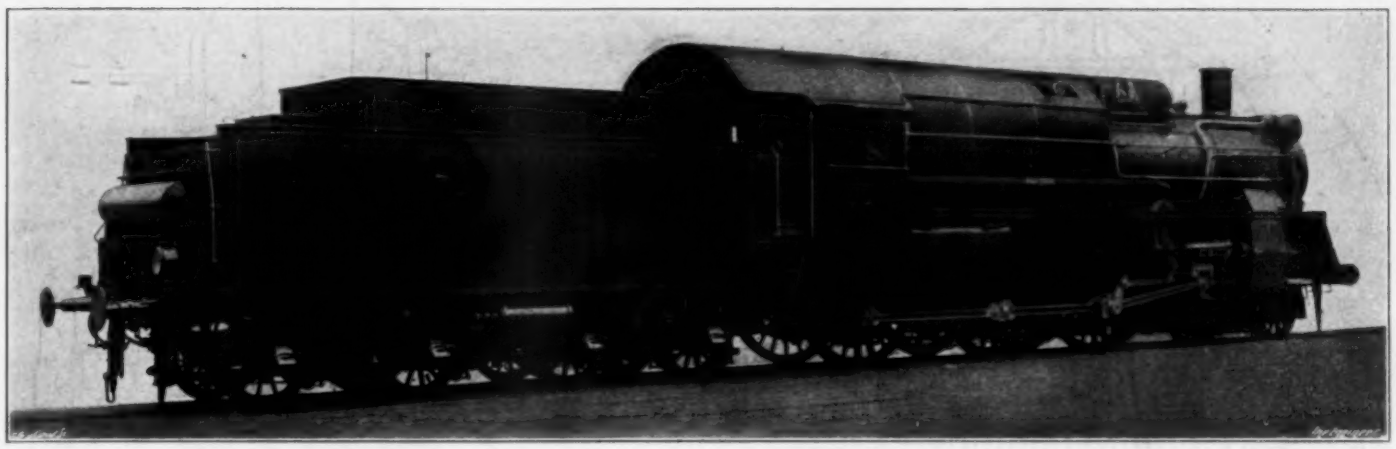
TABULATED RESULTS (*continued*)

Test number.	Boiler Performance. Total steam.	H.P. boiler evaporation.	% H.P. steam to total.	• H.P. steam per square foot heating surface per hour.	L.P. boiler evaporation.	• L.P. steam per square foot heating surface per hour.	• H.P. steam per square foot evaporating coil surface per hour.	Steam Consumption. Loco. Total steam per draw-bar H.P. hour.	Total steam per draw-bar H.P. hour based on the level.	Pumps. Air pump.	Feed pumps.	Loco. After deduction of steam for pumps.	Per draw-bar H.P. hour after deduction of steam for pumps, based on the level.	Coal Consumption. Total coal.	• Per square foot grate per hour.	Per draw-bar H.P. hour, based on the level.	Evaporation per pound of coal.	Calorific value of coal.	Smoke-Box Gas Analysis. CO_2.	CO.	O_2.	H_2.	Excess air.	• Coal per thousand tonmiles—total running.
	Lb.	Lb.	%	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	B.Th.U per lb.	%	%	%	%	%	Lb.
1	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77
1	19,639	11,332	57·7	37·6	8,307	4·75	19·15	18·6	18·4	310	1,014	18,315	17·2	2,767	75·1	2·58	7·10	12,760	11·8	0·4	6·6	0·4	46	87·5
2	36,250	19,599	54·1	44·4	16,651	6·77	22·6	17·3	17·13	445	1,803	34,002	16·1	5,291	97·75	2·50	6·85	12,760	11·2	1·2	6·6	0·4	46	82·0
3	30,380	16,799	55·3	38·4	13,581	5·34	19·5	18·7	18·45	370	1,532	28,478	17·3	3,748	69·8	2·28	8·10	12,760	12·2	0·0	7·0	0·0	50	73·5
4	25,465	14,396	56·5	30·7	11,069	4·05	15·6	20·6	20·9	390	1,301	23,774	19·5	3,576	62·0	2·94	7·12	12,760	12·8	0·4	6·0	0·0	40	70·0
5	26,664	14,704	55·1	34·2	11,960	4·78	17·4	18·9	18·6	346	1,343	24,975	17·45	3,230	61·1	2·25	8·25	12,760	12·0	0·2	7·2	0·2	52	69·25
6	23,722	14,130	59·6	29·7	9,592	3·47	15·1	22·5	23·0	399	1,252	2,071	21·4	2,972	51·0	2·88	7·99	12,760	12·4	0·2	7·0	0·1	50	63·75
7	33,241	17,813	53·6	42·1	15,428	6·28	21·4	17·5	17·24	390	1,645	31,206	16·2	4,539	87·5	2·36	7·33	12,760	11·6	0·2	6·6	0·1	46	67·0
8	30,825	17,020	55·2	39·1	13,805	5·45	19·9	18·2	18·4	251	1,559	29,015	17·35	4,343	81·3	2·50	7·10	12,760	12·6	0·2	6·4	0·2	44	64·1
9	42,107	21,517	51·0	48·0	20,590	8·07	24·9	16·7	16·6	556	2,026	39,525	15·6	6,232	116·0	2·46	6·76	12,760	10·8	0·4	7·4	0·1	54	81·5

NOTES.—Col. 57: Calculated on the heating surface of tubes exposed to the fire, viz., 217·43 square feet. Mg. = Magdeburg. Wp. = Wildpark. Cn. = Cöthen.
• These figures are based on total running times.

HIGH-PRESSURE TWO-PRESSURE LOCOMOTIVE

HENSCHEL & SOHN, KASSEL, ENGINEERS



The Schmidt-Henschel High-Pressure Locomotive.

So much has been heard during the past few months about the use of very high pressure in locomotives that we are glad to be able to put before our readers to-day, as a Supplement, longitudinal sections through the remarkable high-pressure two-pressure locomotive, built by Messrs. Henschel & Sohn, to carry out the invention of the late Dr. Schmidt. The feature of this engine is the use of a boiler which generates steam at two pressures, one in the neighbourhood of 900 lb. and the other of 200 lb. The high-pressure steam, which is generated by the Perkins closed-circuit method, is used in a single high-pressure cylinder, and, on exhausting, is mixed with low-pressure steam and admitted to two outside cylinders.

For the purpose of the experiment it was decided to use a standard type of locomotive, and to make as few changes in it as possible. A locomotive of the S. 10^2 type, No. H. 17,206, belonging to the German Federal Railway Company, was selected, and the principal alterations made were the provision of new cylinders and a new two-pressure boiler, in accordance with the patents of the Schmidt'sche Heissdampf Gesellschaft, m.b.H. The following are the principal dimensions of the locomotive after conversion :—

(1) *Boiler.*

(a) *High-pressure Boiler.*

Boiler pressure	882 lb. per sq. in.
Heating surface of water tubes (fire side)	217·43 sq. ft.
Diameter of water tubes	1·655in. inside 2·01in. outside
Heating surface of evaporating coils in high-pressure drum (outside surface)	426·25 sq. ft.
Diameter of tubes of evaporating coils in high-pressure boiler	1·26in. inside 1·495in. outside
Length of high-pressure drum	16ft. 11in.
Internal diameter of high-pressure drum	3ft.
Water content at lowest level	62·15 cub. ft.
Area of water surface	28·4 sq. ft.
Height of lowest water level above centre of tank	3·94in.
Heating surface of high-pressure superheater	430·56 sq. ft.
Diameter of superheater tubes	0·71in. inside 0·945in. outside
Number of high-pressure superheater elements	30

(b) *Low-pressure Boiler.*

Boiler pressure	206 lb. per sq. in.
Diameter of boiler	5ft. 3in.
Length between tube plates	13ft. 9¼in.
Number of smoke tubes	116
Diameter of smoke tubes	3·02in. inside 3·27in. outside
Heating surface (gas side)	1259·38 sq. ft.
Water content at lowest level	127·13 cub. ft.
Area of water surface	53·8 sq. ft.
Heating surface of low-pressure superheater	426·25 sq. ft.
Diameter of superheater tubes	0·71in. inside 0·945in. outside
Number of superheater elements	56

(c) *Grate Area.*

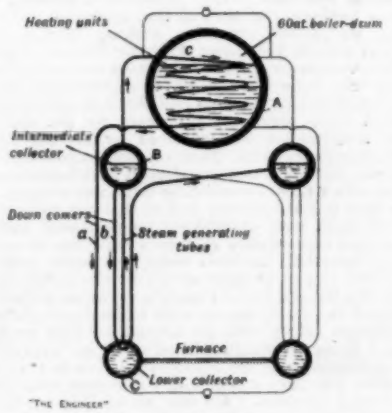
Length	9ft.
Width	2ft. $11^9/_{32}$in.
Area	26·59 sq. ft.

(2) *Steam Engine.*

Diameter of driving wheel		6ft. 6in.
Diameter of cylinder—		
One high-pressure		11·42in.
Two low-pressure		19·7in.
Piston stroke		24·8in.
Volume of cylinders—		
High-pressure		2271·6 cub. in.
Low-pressure		7371·7 cub. in.
Clearance—		
High-pressure :	Front	11·2 per cent.
	Back	11·2 per cent.
Low-pressure :	Front	10·99 per cent.
	Back	10·3 per cent.
Ratio of cylinder volumes (one high-pressure, two low-pressure)		1 : 6·5

The high-pressure boiler, which consists of a drum placed above the fire-box, is indirectly heated by internal elements which receive heat from a water-tube fire-box and combustion chamber—see diagram. The fire-box walls consist of tubes, 2in. external diameter, 1·65in. internal diameter. They are filled with distilled water, which is constantly in circulation. This water is evaporated in them, and the steam generated passes through heating elements which are situated in the high-pressure drum. The heating steam transmits its latent heat through the heating elements to the water in the high-pressure drum, and the condensate flows back through tubes situated at the back of the tubes forming the fire-box sides and returns to the lower foundation rings. It should be particularly noticed that since the same water is always in circulation, no incrustation of the tubes can take place, and, assuming that the water is freed of all its contained air, there should be no risk of corrosion.

Intermediate drums are provided between the foundation rings and the heating elements situated in the high-pressure drum to separate the steam and water. The latter, thus separated, passes down tubes which are also situated at the back of the tubes forming the sides of the fire-box. It is thus quite evident that not only is an intensive evaporation maintained in the water tubes, but also a rapid circulation which, in turn, ensures efficient protection of the water tubes, even at the highest firing rates. Half of the water tubes composing the fire-box are arranged in such a way that they cross each other immediately below the high-pressure drum, and thus



close the combustion chamber at the top and protect the drum from the influence of the fire-box gases.

The water-tube system of the fire-box was originally divided into six sections, each containing from 17½ to 24 gallons of water. Subsequent to the trials which were carried out from February 2nd to March 26th, 1927, by the German Federal Railway Company, these six sections were reduced to two. As a result, there is more uniform pressure throughout, and, consequently, more regular temperature and evaporation, in the high-pressures drum.

The low-pressure boiler is of the ordinary type, having flue tubes, 3in. diameter, all containing superheater elements. According to actual evaporation trial tests, the high-pressure boiler produced something like 66 per cent. of the total steam at a firing rate of 30 lb. of coal per square foot of grate area. But at a firing rate of 92 lb. per square foot, the corresponding share of the high-pressure steam was only 47 per cent. The low-pressure boiler also acts as a feed-water heater for the high-pressure boiler. The feed water is drawn from the tender and fed into it in the usual way. Hence, the scale deposits are, to a large extent, separated in the low-pressure boiler, and there is very little, if any, deposition in the high-pressure drum.

Part of the water which is heated in the low-pressure boiler to the temperature corresponding to the pressure is fed to the high-pressure boiler through a hot water pump. The high-pressure boiler has, in consequence, to transmit little more heat than that required for evaporation, and thus the well-known advantage of a very hot feed are secured.

Should it be required, high-pressure steam can, by means of a valve controllable from the cab, be admitted into the low-pressure boiler. When raising steam, full pressure in the high-pressure boiler can be obtained in 20 minutes. The low-pressure boiler is slower in reaching its full pressure. But if the surplus high-pressure steam be blown into the low-pressure boiler by means of this valve, the working pressure in that boiler can be quickly attained.

The supply of high-pressure steam is controlled by a regulator, which is worked in the usual manner from a lever in the cab. The same regulator rod also controls the supply of steam to another regulator controlling the low-pressure steam. That is to say, the supply of high-pressure and low-pressure steam is controlled by separate regulators, but they are actuated by a single control, common to both.

After leaving the high-pressure regulator, steam passes into a superheater situated in the lower boiler tubes, where its temperature is raised to approximately 750 deg. Fah. It then enters the high-pressure cylinders. The exhaust from the high-pressure cylinders mixes with low-pressure steam, which has been superheated to a temperature of approximately 800 deg. Fah. in a superheater situated in the upper boiler tubes. This mixture of exhaust and low-pressure steam is then used in the two low-pressure cylinders.

The operation of this locomotive is similar to that of the ordinary type. There is only one regulator handle, but there are two water gauges to watch and two boiler feed systems to handle. An indirect water gauge is used for the high-pressure boiler, but it has been found that it is not necessary to pay such particular care to the height of the water as in the case of an ordinary locomotive boiler with a crown sheet. In the event of the heating elements becoming temporarily uncovered, no damage is occasioned. The firing, however, is lighter in this method of steam generation, so that there is ample time to attend to these duties.

The valve gears of the high-pressure and low-pressure cylinders are of the conjugated type, the use of which is made possible because the required cut-offs in both the high-pressure and low-pressure cylinders are approximately the same, owing to supplementary low-pressure steam being provided.

The initial trials showed up several defects, but they were of a minor character, and did not affect the design in general. As previously stated, the heating elements were formerly in six sections, and after the trials these six sections were reduced to two. In the table given on page 80, the six sections are numbered separately.

Steam from the low-pressure boiler was found to be relatively wet, and the superheat in the low-pressure cylinders lower than was anticipated. In addition, the full steam pressure in both boilers was not maintained, as the blast pipe action was not satisfactory. Furthermore, the lagging of the water-tube fire-box was not quite air-tight, so that, in consequence of air leaks, combustion was not very efficient. These various defects have now been remedied, and it is anticipated that coal savings will be further increased. Alterations have also been made to the cut-off.

TRIALS.

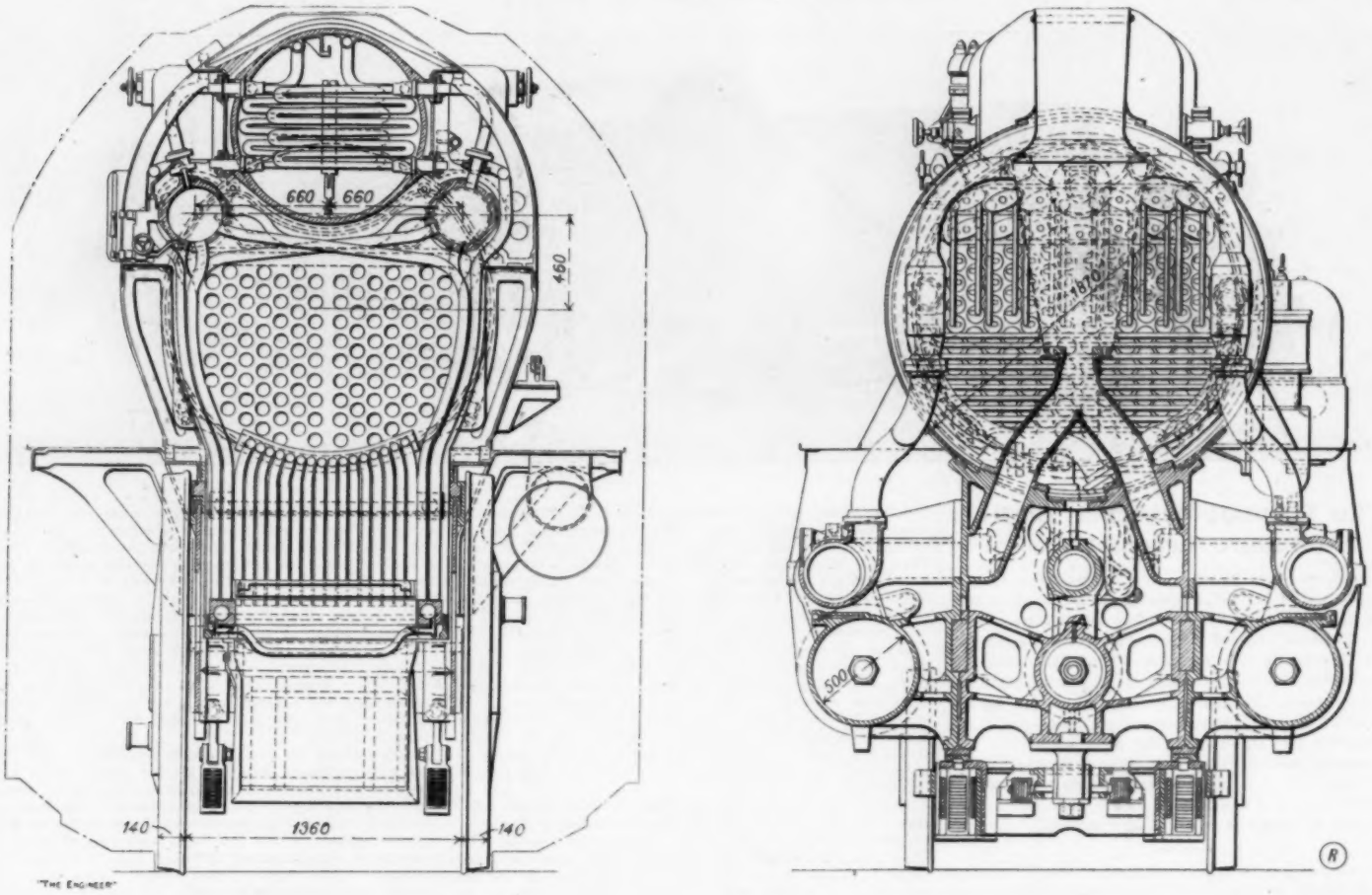
The trials, of which the results are tabulated on page 80, were carried out by the German Federal Railway, with the aid of a dynamometer car on a section which is practically level. It was unfortunate that during the trials speed had to be reduced over a portion of the section, owing to reconstruction work being carried out. The quantity of feed water was measured by a water meter ; the quantity of water pumped from the low-pressure boiler into the high-pressure boiler was also measured. Indicator diagrams were taken every 3·1 miles.

Upper Silesian large coal with a calorific value of 12,760 B.Th.U. per pound was used. The steam consumption per draw-bar H.P.—see table—is calculated after deducting the steam used for pumps. It must be borne in mind that the speed of this high-pressure locomotive in the trial runs was considerably higher than that of other locomotives, and also that the others were built for heavier duty. The average speed for the running time under steam was 49·7 to 51·6 miles per hour ; the actual speed when running unchecked was mostly between 59·9 and 62·1, the difference being accounted for by starting, stopping and slow running owing to the reconstruction work.

The high-pressure feed pumps, as was determined by test, consumed an equivalent of 5·5 per cent. of the water pumped, and the low-pressure feed pump 2 per cent.

The effective heating surface of both high and low-pressure boilers is calculated on the surface in contact with the fire gases. A moisture of 10 per cent. in the high-

HIGH-PRESSURE TWO-PRESSURE LOCOMOTIVE—CROSS SECTIONS



pressure drum was allowed for, and it was also assumed that the low-pressure steam reached the superheater with 10 per cent. moisture.

On the constructional and operating side of this design, it should be noted that there are no stayed surfaces, either in the indirect system or in the high-pressure steam drum; consequently, the factor of failure is lessened and the factor of safety increased. The closed circuit system does not require much water, and even if a failure took place in any of the tubes, the result would not be serious, certainly not half so serious as the bursting or blowing out of an ordinary flue tube in the standard type locomotive boiler.

The clearing of any sludge which may be deposited in the drum is quite easily effected, and, as stated above, the indirect heating system is a closed circuit and uses water which is scale and corrosion-free. In practice, the firing up of a boiler with the indirect heating system can be done much more rapidly and with less stressing of the boiler material than with the usual type of steam generator.

As compared with a boiler of the ordinary type for a locomotive, there is little or no increase in the weight of the two-pressure high-pressure boiler. We are told that designs have been got out which show that it can be readily fitted, within the limits of gauge and axle load, to existing types of locomotives in this country. We are also informed that the engine, when stripped after service, showed no greater wear on the various parts—piston-rods, packings, bushings, cylinder walls, piston valves—than would occur in a locomotive under ordinary pressures. Lubrication has given no trouble.

It must be borne in mind that this boiler and the alterations to the engine on which it is fitted were carried out entirely from theoretical calculations. There was no previous practical knowledge of exactly what would be the proper proportions, either of cylinder volumes or heating surfaces required to produce the results which have been obtained, nor was there any practical experience of how the engine would work in actual service until it was built. Some changes—as, for example, the reduction of the groups of high-pressure boiler heating elements to two in place of six—have already been made, and others are in contemplation.

A careful examination of the long table of trial results which we are enabled to give through the courtesy of Dr. Wagner and of The Superheater Company, Ltd., of 195, Strand, London, who handle the design in this country, will well repay the time spent by those who are interested in the details of locomotive performance.

Institution of Mechanical Engineers.

NORTH-WESTERN BRANCH.

AT a meeting of the North-Western Branch of the Institution of Mechanical Engineers, held on January 5th, in Manchester, Mr. E. G. Herbert presented an abstract of his paper on "Cutting Temperatures: Their Effect on Tools and on Materials Subjected to Work." In the discussion which followed, Professor Dempster Smith, after congratulating the author on his paper, said he agreed with Mr. Herbert that increased productivity could only result from an improvement in the cutting tool. He was inclined to agree with him also that the cutting capacity of a tool could only be judged by testing it in the neighbourhood of the temperature at which it would be worked, and although an abrasion test most closely agreed with working conditions, a hardness test such as that suggested was a big advance on present practice. Coming to the really important part of the paper, Professor Dempster Smith said that some years ago, in conjunction with a Mr. Israel Hey, he had undertaken a set of experiments on the Herbert steel testing machine and obtained results which confirmed those previously submitted by Mr. Herbert. Further confirmation was obtained by another set of tests in an ordinary lathe. In this last series he found that the force on the tool varied considerably at different speeds, and that was a thing for which he could not account. At a later date it had occurred to him that the hardness of the steel might vary at different temperatures, and the tool be more easily dulled at some speeds than at others. A set of Pendulum hardness tests* was made and the results were similar to those shown by the author in his Fig. 4. Mr. Herbert showed that the variation in the force with speed was partly due to work hardening at different temperatures. Even with the information now available Professor Dempster Smith said he could not explain the cause of the peaks in the durability curves in the paper referred to, but there was no doubt that they were partly due to work hardness. He was afraid that whilst the figure of merit to which Mr. Herbert had referred would be of very great use to the experimenters in that subject, the tests would be difficult to make in the workshop. A simple test was required to check the work of smith or hardener. The chemical composition of steel and its treatment were not the only two factors affecting the material. The method of melting, casting, and subsequent working had a very pronounced effect on the quality of the steel.

Mr. Carter said there was undoubtedly much in the paper of very great merit, but Mr. Herbert had fallen into the trap of most investigators: he merely made a statement, but did not prove it. He had stated that the best curves were obtained by hardening at 1300 deg. and re-hardening at 576 deg. There was not, however, a single case in the paper where tools had been so prepared and had proved the results. Mr. Carter suggested that the statement would have carried much greater weight if half-a-dozen tools had been prepared and treated in that manner and tested against other tools otherwise prepared. He was not prepared to accept the truth of that statement. The Manchester Association, after a re-investigation, had decided that 1350 deg. was a better temperature than 1250 deg. In that re-hardening there was a point which they sought. The initial object of tempering was to impart added fineness to the tools, and Mr. Carter said he thought that they ought to be shown the physical characteristics of the steels compared with the cutting characteristics after such treatment. He had attempted to do that as long ago as 1910.

Mr. Onions said it was a simple thing to make a tool to deal with mild steel, but the greatest difficulty was met in getting a tool that would meet all conditions in cast iron. It would be of considerable assistance if someone would come forward and give engineers some method of determining when a tool was a good one or when it was a bad one, as regards hardening and passing into the tool-room before being passed into the shop again. That, as Professor Dempster Smith would remember, was one of the points they had been up against, and they had never been able to solve it. The scleroscope reading was not to be relied upon in that class of work.

Mr. J. M. Newton said that he agreed with Mr Carter that no proof was offered in the paper that the hot-hardness was an exact measure of the cutting value of the tool. It was probably true, but he would like, he said, to have some definite evidence of it. That idea had first been put before engineers some twenty years ago by Professor Arnold. Mr. Newton thought it would be an advantage if engineers had experimental proof that hot-hardness was a real measure of cutting capacity, and he suggested that people who controlled machine shops might do something to gather a body of data together by trying tools with a known figure of merit and showing how they behaved, as compared with other tools of a different order of merit, on repetition work. If data of that kind were given to societies in discussions on similar papers it would be of great value.

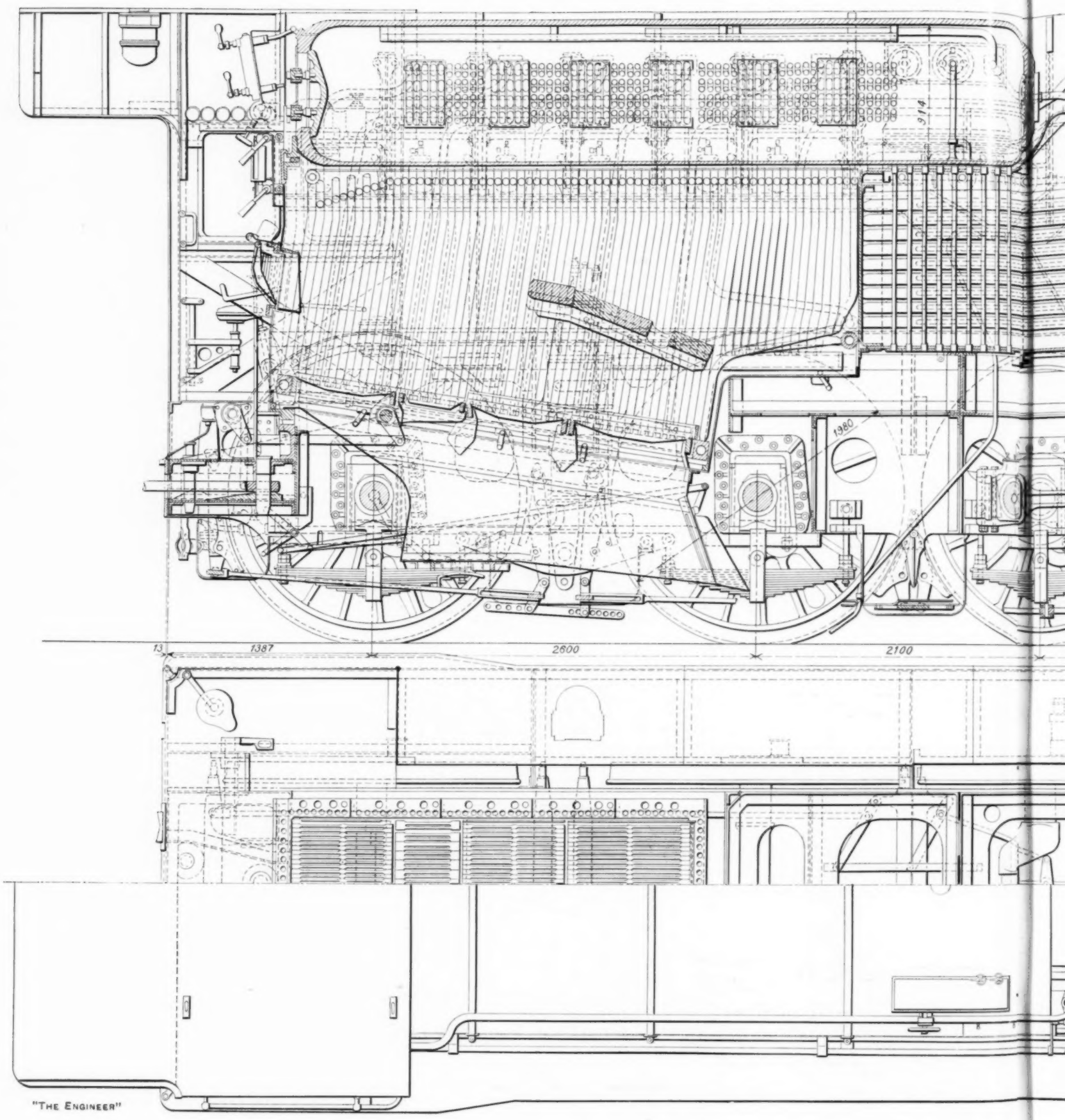
Mr. A. T. K. Kersey said he had had a little experience of the use of the pendulum tester, but only on cold working, and he had found that quite small changes of temperature would change the results from the tester. When used on the furnace it seemed to him that quite an appreciable amount of heat might escape to the instrument itself, and that, in inexperienced hands, at any rate, the results might be somewhat erratic.

Mr. Herbert, in replying to the discussion, said Professor Dempster Smith had suggested that an abrasion test might be used. An abrasion test was apparently the ideal test; but, unfortunately, it was one which was very difficult to carry out, and it was a long test. He put forward the hot-hardness inspection test because it could be carried out as a practical method of investigating tools in quantities and would not take much time. With reference to the peaks in the durability curve and the possible connection with the changes in the tool steel, he said that he had suspected that they could only attribute that to something occurring in the tool, but later on he had come to the conclusion that there were no fluctuations in the hardness of the tool that could account for those curious peak curves which he had produced very long ago, and which Professor Dempster Smith and his co-workers had produced at the College of Technology. Hence he had come to the conclusion that changes were taking place in the material, and not in the tool. As to the figure of merit being of no use, it was a question, to his mind, whether engineers were to judge their tools at all beforehand, or whether they were to take them for granted and hope they were good. The usual practice at the present time was to test tools cold, but it was agreed that the cold-hardness test did not give very much useful information. The hot-hardness test did distinguish qualities, and was an important property. He was substituting the hot-hardness test for a cold-hardness test. The one showed one of the most important qualities of the tool, and the other did not show anything, so that he hoped that the figure of merit would not be deemed as being quite of no use. Tool makers seemed to be at an early stage in which they took the whole thing for granted. They had no means of judging whether they had

* "Proceedings" of the Institution of Mechanical Engineers, 1925.

SCHMIDT-HENSCHEL HIGH-PRESSURE

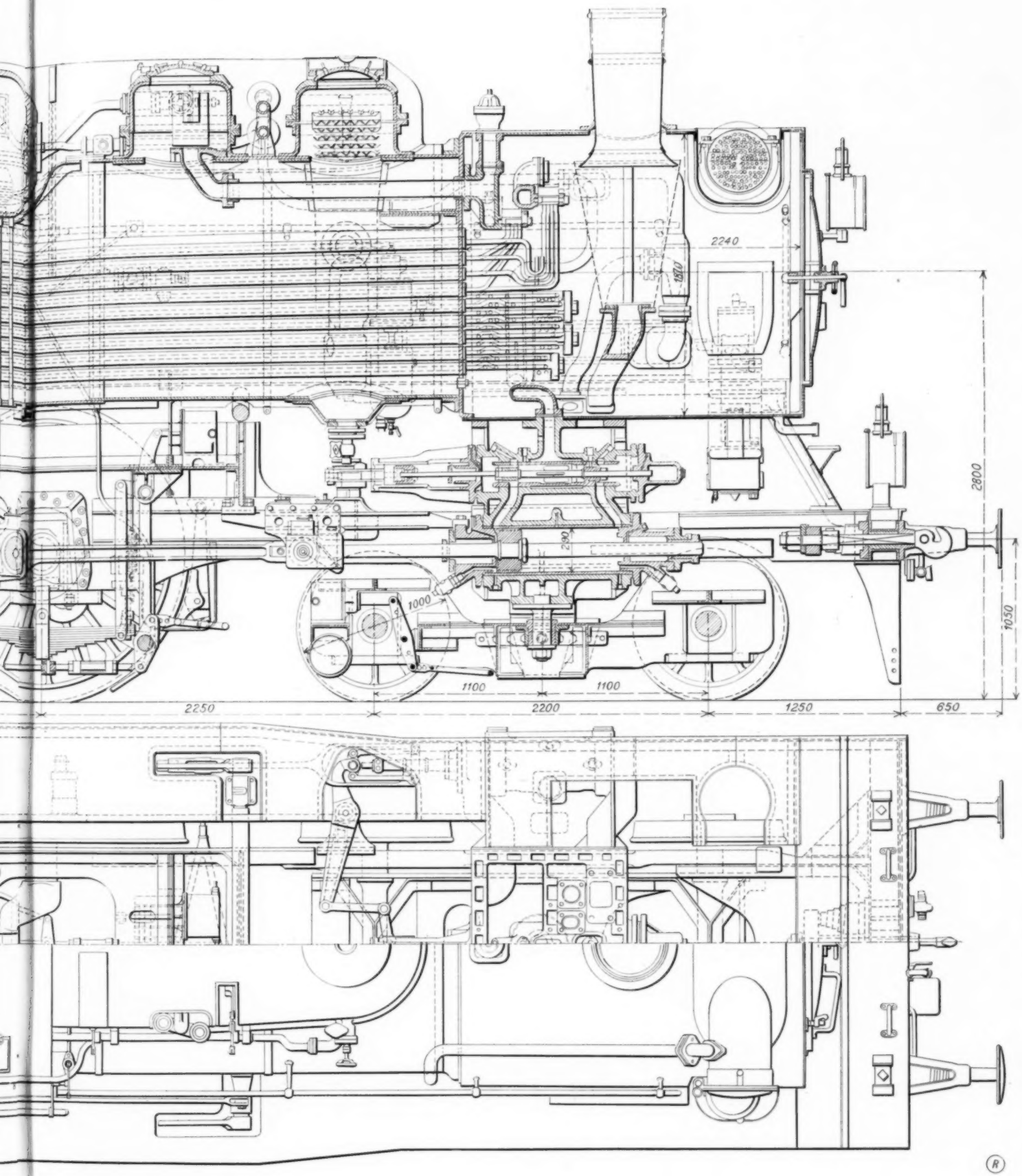
HENSCHEL & SOHN, CASSEL.



"THE ENGINEER"

SURE TWO-PRESSURE LOCOMOTIVE

DHX, CASSEL, ENGINEERS



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UNIV. OF MICH.

ONE-TON MOTOR ROLLER

TANGENT TOOL AND ENGINEERING COMPANY, LTD., KEYNSHAM, ENGINEERS

hot-hardness or anything else. He suggested that they should investigate the individual physical characteristics. They ought to be able to find from any steel maker what the softening temperature of the steel was when it was given treatment that was recommended. Mr. Newton had raised a point that the hot-hardness was to be compared with the tensile strength, and that was the view that he personally had taken. It was the most essential quality of the tool, but it was not the only one.

A One-Ton Motor Roller.

THE motor-driven roller which is illustrated by the above engraving has just been brought out by the Tangent Tool and Engineering Company, Ltd., of Keynsham, near Bristol, with the idea of providing a machine which will obviate the necessity for hand tamping in making road repairs and, incidentally, the general rolling of repair work in road maintenance.

The total weight of the machine, excluding the attendant, is 24 cwt., and includes 4 cwt. of water in the main roller, which is 3ft. wide by 2ft. in diameter and is made in two halves for convenience in steering. The two parts can, however, be locked together by means of a spring plunger for straight work. The engine is of the J.A.P. half-litre four-stroke type and is fitted with a Pilgrim positive oil pump to provide automatic lubrication. The engine is cooled by means of a fan, and the engine cover, which can be completely removed by undoing three spring clips, is so arranged that a stream of air plays directly on the engine, keeping it cool under the most adverse conditions. The carburetter is of the Villiers single-lever type and is fitted with an air filter on the inlet side, so that no dust can find its way into the cylinder. The power is transmitted through a gear-box and Renold roller chain, which give a speed reduction of ·75 to 1, to the back roller. The engine can be throttled down so as to give a rolling speed as low as half a mile an hour, while gradients as steep as 1 in 7 can be surmounted. The gear-box includes two cone clutches for going ahead and reversing, with a neutral position in the middle. There is only one lever, so that the control is very simple, and it is claimed that the roller can easily be manœuvred backwards and forwards on the length of an ordinary brick. The clutches can be adjusted by means of bolts which extend outside the casing and have self-locking nuts. The nuts are spring-loaded into notches, but can be turned in either direction to effect the adjustment. Two brakes are fitted, foot operated and hand operated, the latter being ratchet controlled. The frame is made of steel and is well braced by means of heavy tie bolts and large diameter tube stiffeners. It is sprung, and in addition to this a spring seat is fitted to ensure that the road vibration does not reach the driver and so cause undue fatigue. Starting of the engine is effected through a second shaft of the gear-box, giving a speed up to 5 to 1, so as to ensure a quick start in cold weather.

Auxiliary Oil Engine Drives on Board Ship.*

DURING the past few years there has been a very great increase in the use of oil engines for driving the auxiliary machinery of ships. In ships fitted with marine oil engines, steam auxiliary plant has been almost entirely superseded, and the auxiliaries generally derive their power from oil engine-driven generators. Even for vessels with steam main machinery there is an increasing tendency to take advantage of the economy of oil-electric auxiliary plant in place of inefficient steam auxiliaries or turbo-generator plant with electric auxiliaries.

In the following table the various types of engine are classified and approximate figures for weights per brake horse-power, fuel consumption, and lubricating oil consumption are given.

Engine type.	Weight, lb./B.H.P.	Fuel consumption, lb./B.H.P. per hour.	Lub. oil consumption, gals./100 B.H.P./day.
Four-stroke air injection with trunk pistons ..	175	0·39	1·2
Four-stroke airless injection engine with trunk pistons :			
Pre-combustion chamber injection	168	0·39	1·2
Direct or accumulator valve injection	168	0·38	1·2
Two-stroke air injection engines with crossheads and crank chamber separated from cylinders by gland on piston-rod ..	165	0·43	0·6
Two-stroke airless injection engine with crossheads with pre-combustion chamber injection ..	135	0·42	0·5

These figures are based on engines of about 300–400 B.H.P., but the relation between the different types would, says the author, be much the same for any power at present required for marine auxiliaries.

For marine work, reliability, and a long period of running service without attention are of much greater importance than an exceptionally low fuel consumption on test, which is difficult to maintain in service.

Dealing with the vibration of auxiliary machinery, it is remarked that for all ships, but particularly passenger ships, freedom from vibration is of the greatest importance. Two kinds of vibration may occur. The most common is due to unbalanced forces in the auxiliary engine synchronising with either the natural frequency of its seating or of the ship as a whole. Such vibration is not liable to cause serious breakdown, but is extremely unpleasant to passengers and crew, and causes considerable upkeep cost owing to the slackening of rivets, &c. The other kind of vibration is due to synchronism of a component of the engine torque variation with a natural frequency of torsional vibration of the engine shafting. This torsional vibration may cause dangerous stresses in the shafting without any very marked indication of its presence, although vibration of the engine and its seating occurs when running very close to the critical speed, and, in the case of a generator set, the existence of such a vibration is often shown by a flickering of the light. A critical condition of torsional vibration is extremely dangerous, as it is bound to lead to a breakage of the shaft or other serious defect very soon after the engine is put into service. With the normal proportions and speed of modern Diesel engines the risks of critical torsional vibration is perhaps greatest in the case of six-cylinder engines driving generators. Both in the paper itself and in an appendix information is given as to methods of calculation by which the natural torsional frequency of vibration can be determined, attention being drawn to the differences in the value of this frequency for light and fully loaded ships.

After dealing with the subject of vibration the author goes on to consider the question of the number of auxiliary generator sets which it is desirable to install in a ship. In the past, he says, it has been common practice in motor ships to install two auxiliary generating sets, either of which is capable of carrying the maximum electric load that is likely to be required. Such an arrangement is uneconomical, both from consideration of first cost and running costs. In cargo ships the normal sea load is rarely more than half the maximum load, and the generator engine is therefore running for the greater part of its life at a very low load, and, consequently, poor efficiency. In the first cost the owner is paying for twice the maximum power that he requires. A much more suitable arrangement is to provide three generating sets, two of which will take the maximum load, while one can run economically at approximately full load to meet the conditions at sea. This arrangement has the further advantage of allowing overhaul work to be carried out on one generator at a time, while leaving a standby always ready to be started. Complete overhauls can be made periodically on each set. In this way the generator engines can always be kept in first-class condition. If two larger sets are provided no standby is available when overhaul work is being done on one set. In first cost the three small sets offer a reduction of at least 20 per cent. as compared with the two large sets. The driving of auxiliary air compressors, both combined with generators and also as separate units, is considered and reference is made to electrically-operated deck auxiliary machinery and the Reavell low-pressure air system for winch driving. The paper concludes with some interesting figures for the actual fuel consumptions of the auxiliaries on similar ships fitted with steam and oil-electric drives, which are given below.

Type of ship.	Type of auxiliary machinery.	Tons per day of fuel oil at sea normal load.
Refrigerated ships about 6000 S.H.P., about 9000 tons d.w.c.	Steam	18
	Oil-electric	2·4
Oil tankers about 3000 S.H.P., 10,000 tons d.w.c.	Steam	3
	Oil-electric	0·3
General cargo, 8000 tons	Steam	2·5
	Oil-electric	0·2

According to the author, auxiliary power in a turbine-driven ship usually represents about 3 per cent. of the main engine power. The consumption of steam auxiliaries is in the region of 40 lb. of steam per auxiliary horse-power hour, which is equivalent to about 3·5 lb. per B.H.P. hour of oil. This rate of consumption is about five times as great as that of the main turbine, so that, although the auxiliaries only develop 3 per cent. of the total power, their consumption is of the order of 15 per cent. of the total.

With oil-electric auxiliaries, after allowing for electric losses in generators and motors, the consumption is only about 0·5 lb. per auxiliary horse-power, representing only some 2 per cent. of the consumption of the main engines.

* From a paper read, January 13th, before the North-East Coast Institution of Engineers and Shipbuilders, by J. Calderwood, M.Sc., entitled "Diesel Engine Drive for Generators and other Auxiliary Machinery on Board Ship."

IRON AND STEEL IN 1927.

FROM the latest figures circulated by the National Federation of Iron and Steel Manufacturers, we learn that the number of furnaces in blast at the end of December was 149, a net decrease of six since the beginning of the month, nine furnaces having gone out of operation and three having been put into blast. The production of pig iron in December amounted to 559,100 tons, compared with 575,900 tons in November and 596,300 tons in October. The production included 181,200 tons of hematite, 175,400 tons of basic, 161,600 tons of foundry and 22,200 tons of forge pig iron. The December output brought the total for the year to 7,293,600 tons, compared with 2,458,200 tons in 1926, 6,261,700 tons in 1925, and 7,307,400 tons in 1924. On account of the Christmas holidays, the production of steel ingots and castings declined to 604,900 tons in December from 698,700 tons in November and 699,000 tons in October. The December figures brought the total for the year to 9,097,900 tons, compared with 3,596,100 tons in 1926, 7,385,400 tons in 1925, and 8,201,200 tons in 1924. The output of steel in 1927 was thus the highest attained since the war, just slightly exceeding the output of 9,067,300 tons, which was the total for 1920.

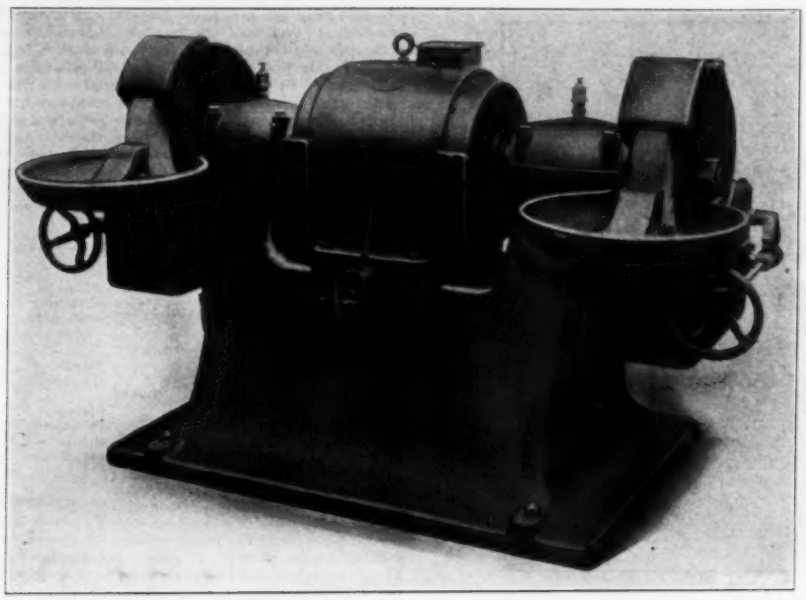
The following table shows the average monthly production of pig iron and steel ingots and castings in 1913, 1920, 1924 to 1927, and the production in each month since December, 1926 :—

	Pig iron, tons.	Steel ingots and castings, tons.
1913, monthly average ..	855,000	638,600
1920 ,, ,, ..	669,500	755,600
1924 ,, ,, ..	609,000	685,100
1925 ,, ,, ..	521,800	615,500
1926 ,, ,, ..	204,800	299,700
1927 ,, ,, ..	607,800	758,200
1926, December	98,000	319,300
1927, January	434,600	730,700
February	571,100	826,800
March	671,800	949,600
April	680,000	850,100
May	720,100	884,600
June	651,300	747,300
July	645,800	687,100
August	596,100	643,100
September	591,500	777,000
October	596,300	699,000
November	575,900	698,700
December	559,100	604,900

SCHNEIDER TROPHY WINNING SEAPLANE S 5.—On Thursday, January 26th, at 6.30 p.m., at the Royal Society of Arts, 18, John-street, Adelphi, W.C. 2, a lecture will be given on "The Designing of the Schneider Trophy Winning Seaplane S 5." The lecture will be given by Mr. R. J. Mitchell, Mr. P. A. Ralli, and Captain G. S. Wilkinson, jointly. Mr. R. J. Mitchell is the designer and director of the Supermarine Aviation Works and was chiefly responsible for the design of the S 5. Mr. P. A. Ralli was responsible for the design of the propeller. He is the propeller expert of the Fairey Aviation Company, Ltd. Captain G. S. Wilkinson, of D. Napier and Son, Ltd., was responsible for carrying on the work of Mr. Rowledge on the Napier "Lion" engine, and it is stated that it is largely due to the many improvements which he effected that the engine gave the results it did in the race. Only two machines finished and both were "S 5's," and the winning machine put up the remarkable speed of 281·6 miles per hour over the triangular course under difficult conditions. The lecture will be fully illustrated, both by lantern slides and a cinematograph film. Admission is by ticket only, which may be obtained from the Secretary, 7, Albemarle-street, W. 1, and early application is necessary, as the number of tickets will be strictly limited.

ELECTRICALLY-DRIVEN WET TOOL GRINDER

B. R. ROWLAND AND CO., LTD., REDDISH, ENGINEERS

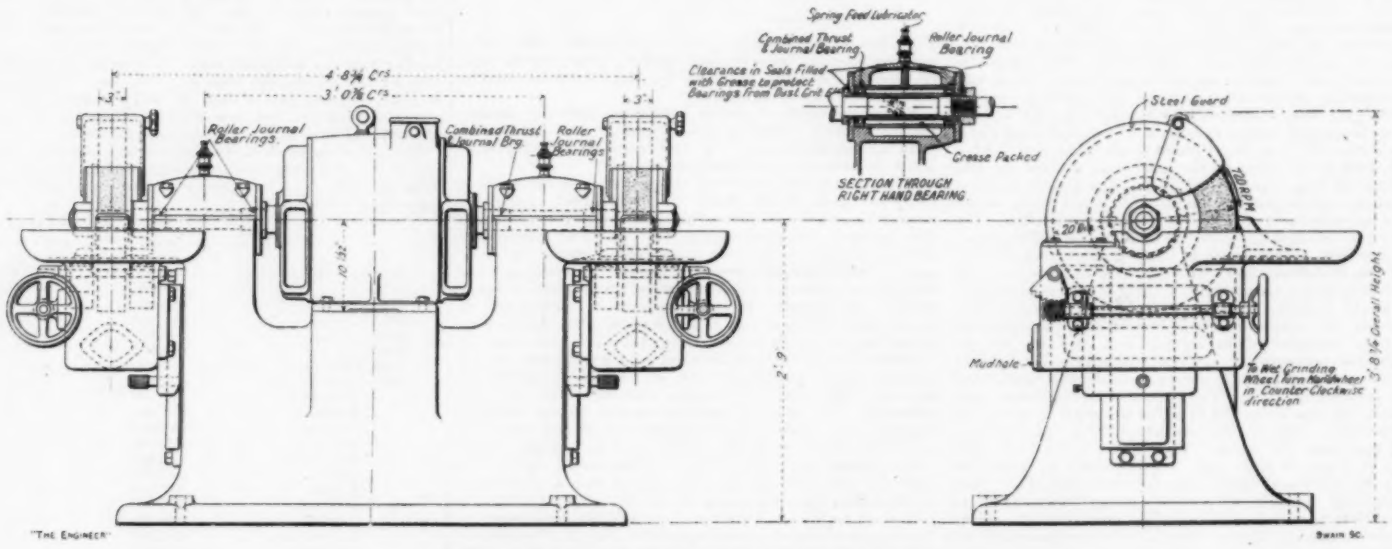


Double Electrically-driven Wet Tool Grinder.

THE accompanying illustrations represent the most recent design of wet tool grinder which B. R. Rowland and Co., L d., Reddish, near Stockport, are putting on the market. The machine is driven either by a direct or an alternating-current motor built specially for the purpose, as standard motors are not suitable. On each end of the machine a wet tool grinding attachment is provided, the lower parts of which form a tank in which a submersible float is provided. These floats are hinged and are depressed into the water by means of the hand wheel and worm gear shown, thus raising the level of the water and controlling the supply from the finest spray to a flood. The upper portion of the wheel is surrounded by an enclosed steel guard and adjustable nose-piece to comply with the Home Office requirements, and a heavy tool grinding rest is fitted in the tray at the front.

To facilitate replacement of the wheels the wet tool grinding attachments are movable, being mounted on slides which enable them to be readily dropped out of the way below the wheel, the hood and nose-piece, of course, having been previously removed. Replacement is in this way rendered easy for unskilled labour and can be effected without the removal of the bearings and the motor. The machine illustrated has 20in. abrasive wheels 2½in. wide and is driven direct by a 4½ horse-power motor running at 950 revolutions per minute in the case of the direct-current motor and at the nearest available speed in the case of an alternating-current motor. The motor is without bearings and is fitted with special end covers to keep dust out of the windings. The armature shaft is of extra large diameter, extended at each end and arranged to run in the grinding machine bearings. The bearings are 2¼in. diameter and are of the Hoffmann anti-friction type, three roller journals being provided to take the load and one combined thrust and journal bearing to keep the shaft in position. These bearings are carefully fitted into grease-proof housings, which have grease seals to protect the bearings from grit. The seals consist of a series of annular tongues and grooves, forming a tortuous path through which all excess grease must exude, and in so doing the clearances are effectively sealed.

Lubrication of the bearings is effected by means of the Tecalemit system of pressure feed. The inner races of the bearings are held in position against the shoulder on the shaft on the inside of each housing behind the grease seal, and the two races are supported by distance pieces on the shaft, the whole being locked solidly in position by means of a nut on the outer end of the shaft. The outer races are located by end covers which are spigoted to keep them in position. Distance pieces are provided to hold them in correct relationship to the inner races. The abrasive wheels are of vitrite corundum made in the builders' works.



DOUBLE ELECTRICALLY-DRIVEN WET TOOL GRINDER

South African Engineering Notes.

British *versus* Foreign Tenders.

THE increasing frequency with which engineering contracts are being secured by foreign firms has been brought into public notice in the Union lately, owing to the very large contracts for locomotives for the Union railways, secured by German firms whose tenders were far below the lowest British tender. The great bulk of the requirements for the railways are, in fact, to-day obtained from America, Belgium and Germany. While the present Government of the Union is unquestionably not prepared to give British goods any such preference as did the Smuts Government—if, indeed, it will give any at all—it is quite evident, on the authority of representatives of the British and American firms who unsuccessfully tendered, that on this occasion the difference in price was so great that no reasonable preference would have availed, and that the Government had really no option but to place the orders as it did. It is not, however, only Government orders which are being lost. Durban is unquestionably the most "British" town in the Union, and may be termed enthusiastically loyal to the principle of giving substantial preference to British goods. Up to a month or so back its electrical engineer claimed that less than one-half of 1 per cent. of the plant of the town's electrical equipment was of foreign manufacture. He will not be able to make that claim for long. The question of accepting a tender for the supply of German made transformers costing £2056 came before the Durban Town Council about two months ago. In the discussion it came out that the lowest British tender was 18 per cent. higher than the German quotations, while the borough electrical engineer reported that the standard of quality of the German transformer was equal to that of the British transformer. The following remarks made by a councillor during the discussion require no comment. He considered that when the difference exceeded 10 per cent. the Council was justified in looking at the economic side. Ten per cent. was a substantial margin to give to the British manufacturer, as against the foreign manufacturer, and the Council should not allow the British manufacturer to "put one across us" to the extent of 18 per cent. This is merely quoted as showing that even the most British community cannot see its way to bridge such big differences. A number of instances might be quoted of other towns, which are refusing to give a preference above 5 per cent. and are therefore giving the orders to foreign firms, and they are becoming more numerous.

Broken Hill Mines.

Vast strides are being made at the Broken Hill Mines, Northern Rhodesia. On October 7th the Governor of Northern Rhodesia, Sir James Maxwell, started the acid plant, with its huge towers, and the only remaining part of the equipment of the mine to be completed is the leaching plant, which it is now hoped will be ready earlier than expected a couple of months back, probably by the end of the year. The towers of the acid plant are lined with sheet lead produced on the mine itself, smelted and rolled in the lead mill on the property. The lead mill is of German make, and gave trouble at first, but since altered and strengthened by the mine staff has been very useful to the construction, having supplied hundreds of tons of lead sheeting and miles of lead pipes which would otherwise have to be imported. This has resulted in a great saving, while expert opinion has it that the lead sheeting and pipes are in every respect as good as the imported articles. Lead pipes are manufactured in sizes from ½in. to 6in. in various thicknesses. This is the only mill of its kind in Africa, except one in Cape Town. The lead for sheet purposes is brought to the mill in 88 lb. ingots, melted into large slabs, approximately 6 tons in weight, then rolled down to about ⅛in. thick, cut to various sizes and finally rolled into various sized sheets of various weights to the square foot. New offices are being built at the mine, which will be the headquarters of the various companies, under Anglo-American technical control, operating in Northern Rhodesia, *e.g.*, Loangwa, Kasenipa, Serenje, Bwana M'Kubwa, and will also house the chief consulting engineer, mechanical engineer and geologist.

Electrification of Suburban Lines.

The electrification of the Cape Town-Sea Point section of the Cape Peninsula suburban system was completed in November, and trains are running very satisfactorily. The electrification of the Cape Town-Simon's Town line is progressing rapidly and trains should commence running at the end of March. The Salt River Power Station will, it is expected, also be completed in that month.

Double-deckers for Motor Cars.

A new type of railway truck has just been built in the Broomfontein railway yards. It is a double-decker for transporting motor cars, and has been invented and patented by Mr. G. E. Titren—Superintendent of Motive Power, S.A. Railways. Four motor cars are transported where only two could be carried formerly. The wheels of each machine fit into metal grooves and the chassis is secured by chains. Cars of different wheel bases and track are carried with equal ease. It is the intention of Mr. Titren to arrange a "ramp" to enable a long line of cars to drive into a line of trucks under their own motive power. These double-deckers are easily converted from the ordinary truck, and the conversion costs about £70. An advantage claimed for them is that when cars are not being carried the trucks can be used for goods and coal in the ordinary way, and that an ordinary truckload of coals or goods can be transported in the lower deck as well as a load of cars on the top deck. On the larger type of bogie trucks six cars can be carried as against three with the old arrangement. The vehicles will be manufactured in the railway yards at Uitenhage, where they will be near the Port Elizabeth motor car assembly factories. It is hoped that the adoption of the double-decker will enable a scheme to be evolved whereby cars for holiday purposes can be transported from town to town by rail at purely nominal cost, well within the means of the average owner.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(*From our own Correspondent.*)

Confined Vista.

THERE is nothing very tangible to report in the way of development in the heavy industries of the Midlands and Staffordshire. The quarterly meeting has come and gone leaving producers and consumers with no clearer view of the forward position than they had at the opening of the year. A hopeful view of the prospects continues to be taken by many industrialists, but the volume of business coming through is not appreciably expanding at the moment, and any new demand which may be latent has yet to show itself. At the quarterly meeting a considerable amount of forward contracting is usual, but last week such contracts were comparatively few. Most consumers adhered to their late policy of buying for immediate needs only, deeming it safer to wait development than to move in advance of actual demand. As delivery of all classes of materials can be had at short notice, they do not fear any market stringency. Moreover, values have of late tended to decline rather than advance, and despite the fact that producers claim values are at rock bottom—even below the profit-giving level in some cases—many users and merchants incline to the belief that they may be able to buy on better terms as the quarter advances. There have been no changes of note in either iron or steel prices on the week.

Pig Iron Values.

While there is no definite alteration in pig iron prices from those recently quoted, the price situation in this department is one in which considerable interest is being evinced. For some weeks past, so concerned by the accumulation of stocks have some smelters become, that they have been shading the recognised quotations in an effort to attact business. Particularly prominent in this matter have been Northamptonshire makers. At the quarterly meeting, however, they made a determined effort to recover their ground. Till just before the market it was possible to buy No. 3 foundry iron at £2 19s., and business was reported to have been done earlier in the week at even less. When the meeting opened, however, £3 per ton was demanded with a unanimity which suggested an agreed and combined action. The effect was to put an end to buying, but furnacemen refused to budge. Derbyshire foundry iron had not been cut to the same extent as Northamptonshire makes, and in this department there were houses ready to sell No. 3 foundry at £3 4s. Better-placed smelters adhered to the old quotation of £3 5s. This week the situation has remained unchanged, and speculation is rife as to whether values will be maintained at the recognised level or whether a reduction to meet the "shading" tactics of the few will eventually be deemed advisable. Under existing conditions buying naturally is cautiously undertaken, most users appearing to favour a policy of covering only immediate needs. Those furnacemen who have kept up their prices maintain that the instability of the market is entirely due to the unbalancing of supply and the demand during the holidays, and that it will right itself. Forge iron is in no better demand than of late. The forges which are working in this district are few, and their purchases of raw material are meagre and spasmodic.

Steel.

Steel prices generally are as last week, there being very little improvement in the demand. The added movement in the shipbuilding industry is bringing business to the steel plate mills, but the demand is still far below the capacity of the modern plant laid down during the last few years. It must be a considerable time before this largely increased capacity in the steel trade can find full employment. There is great keenness for specifications. Orders for constructional steel are light, but the inquiry is fairly plentiful and there is every probability that there will be sufficient work to occupy the engineers for the first few months of the year. It is impossible at the moment to determine to what extent the steel rebate scheme is responsible for the decline in steel imports during the past four months. Only vague statements have as yet been made, and they, of course, carry little weight. There are industrialists who assert that the rebate scheme has had little to do with the decline, and maintain that buyers accustomed to using continental material have generally refrained from transferring their orders to home producers. It is reasonable to assume, however, that quite a number of consumers have considered it expedient to take advantage of the steelmasters' offer and that that has influenced to a smaller or larger degree the quantity of foreign material shipped to this country. Foreign material continues firm, following the recent price hardening. Any weakening in the immediate future is not thought to be likely. The most active department is that dealing in strip, where the changed relation of home and foreign prices for tube strip due to a marked advance of continental prices, has given local mills a better chance of competing. The price of imported strip has risen to £6 15s., or nearly so. Strip re-rolled in English mills from foreign billets is quoted £7 15s. There are many complaints of unpunctual delivery and other shortcomings on the part of the foreigner, and these weigh heavily in the balance against the price difference.

Finished Iron.

In the Staffordshire finished iron trade conditions show very little change. Some of the makers of best grade iron have booked rather more encouraging orders since the price was reduced to £12 10s. There is no great bulk of business on their books. There are signs which lead makers to believe they will have fairly continuous employment for the mills, even though it may come in, as of late, in small orders of the hand-to-mouth character. There is the same disparity, as recently, in the prices of Crown iron. A certain amount of buying of the best grade of Staffordshire Crown bar has taken place since the year opened. This business was negotiated at £10 10s. or upwards. Lancashire and other outside makers continue to offer Crown bars at prices ranging from £9 2s. 6d. The call for chain, cable and anchor iron is variable, but aggregates a reasonable tonnage. The market for common bars for nut and bolt and hurdle making is lifeless. What business there is, and it is increasing of late, the nut and bolt works having received some substantial orders from shipbuilders, is done with suppliers of continental No. 3 iron the price of which is such that even its exceedingly steely nature is overlooked. Wrought iron gas tube strip is in distinctly better request. The price remains unchanged at £11 10s. per ton.

Sheets and Tin-plates.

There is no marked rise in demand for galvanised sheets, either from home or overseas consumers. A slightly better inquiry from West Africa and Nigeria has resulted in some business but the effect is very limited. Galvanised corrugated sheets of 24 gauge continue at £13 basis. Some makers are refusing orders below this figure, while others require £13 2s. 6d. Sheet mills have had a long spell of good business, however, the exports during the past year being well in advance of either the year 1925 or 1926. Tin-plates are in fair demand, the renewed attempt to stabilise the trade having stimulated buying amongst Midland users who fear price increases.

Scrap.

Heavy steel scrap continues at £3 per ton, delivered South Wales. The demand for the time being has spent itself, consequently attempts to force the price above this level have failed.

Trade Survey.

Taking into consideration the general trading conditions which have ruled, the returns of exports and imports of iron and steel and manufactures thereof during December last and for the year 1927 are considered by Midland iron and steel manufacturers to be quite satisfactory. It is noted that during the last month of the year there was an improvement in the export department of £1,832,000. The value of the month's exports was £5,387,962, compared with £3,555,819 in the previous December. On the year, exports showed an advance of no less than £14,368,350. Imports of iron and steel were reduced during the December month, the total quantity imported being 280,520 tons, valued £2,247,601, compared with 517,135 tons and £3,912,194 in the corresponding month of 1926. Taking the year as a whole, however, imports showed an advance. The quantity imported was 4,406,125 tons, value £34,038,410, compared with 3,737,692 tons and £29,512,158 in the preceding year, an increase of 668,433 tons, value £4,526,252.

Fewer Furnaces in Blast.

The number of blast-furnaces producing pig iron throughout the kingdom continues to decline. It is a condition of affairs much to be deplored for until progress is the rule in this department no marked revival in trade generally is to be looked for. During December last nine furnaces were blown out while only three were brought into operation, a net decrease of six. The current year opened with only 149 active furnaces. The fall in output of raw iron during December is quite understandable. The furnaces blowing did very well, however, producing 559,100 tons, compared with 575,900 tons in November by a larger number of furnaces. In October the output amounted to 596,300 tons. Of the iron produced in December, 181,200 tons were hematite, 175,400 tons basic, 161,600 tons foundry, and 22,200 tons forge. The yield for the year is not considered discouraging, the total of 7,293,600 tons being in advance of the 6,261,700 tons turned out in 1925, though it falls slightly below the 7,307,400 tons manufactured in 1924.

Gratifying Steel Production.

Midland industrialists express considerable satisfaction with the latest returns of steel production. It is gratifying to discover that the output of steel last year was larger than in any year since the war, just slightly exceeding the returns of 9,067,300 tons, which was the total for 1920. The total for 1927, 9,097,900 tons, was a big increase on recent years, comparing with 3,596,100 tons in 1926, 7,385,400 tons in 1925, and 8,201,200 tons in 1924. On account of the Christmas holidays the production in December of steel ingots and castings declined to 604,900 tons from 698,700 tons in November and 699,000 tons in October.

India-rubber in Suspension of Vehicles.

Addressing a joint meeting of the Birmingham and District section of the Institution of the Rubber Industry and the Institution of Automobile Engineers at Birmingham recently on "India-rubber as an Auxiliary to Suspension," Mr. F. W. Lanchester detailed various tests and experiments that had been conducted into the properties of the material, and said within certain limitations india-rubber might be employed wherever steel was made use of in the suspension of a vehicle, save that the method and mechanism of its application required to be appropriately modified. But one great advantage of india-rubber was that it was self-damping, whereas in the case of steel it had become customary, and it was indeed considered necessary in most cases, to fit the so-called shock absorber, which was, in fact, nothing more than a suspension damper or dash pot. While, without doubt, it would be possible to design a suspension in which steel was wholely replaced by rubber—and proposals to that effect had been made—the more practical idea at the moment was to regard rubber as an auxiliary.

Obituary.

A large circle of friends in the engineering industry will learn with regret of the death of Mr. James Wilfrid Harris, M. Inst. C.E., M.I.E.E., Mem. Am. Soc. M.E., which took place on Saturday last at Tettenhall, Wolverhampton. Mr. Harris was governing director of the firm of Alfred Wiseman, Ltd., Birmingham. In his earlier years he travelled the world and worked on electric engineering plant in British Columbia. He spent some time at Pittsburg, and later was associated with the Westinghouse Company's works at Trafford Park, Manchester. For a time he was electrical engineer of the Dominion Iron and Steel Company, Nova Scotia.

Unemployment.

The latest available unemployment returns demonstrate the extent to which the various Midland industries are returning to normal working conditions after the Christmas holidays. Whereas the last returns showed an increase of nearly 50,000, the current total is less by 27,613, and a further substantial decrease is anticipated next week. In the Birmingham area the total number of unemployed now stands at 29,288 and in Coventry 3419.

LANCASHIRE.

(*From our own Correspondents.*)

MANCHESTER.

Exports of Textile Machinery.

SHIPMENTS of British textile machinery in December were below the monthly average for the past year, but the falling off was due purely to seasonal influences, and altogether it may be said with justification that the month brought to a close a year which, from the point of view of export trade at all events, was not an unsatisfactory period for textile machinists. The total exports to overseas markets during December were valued at £920,655, of which spinning and twisting machinery accounted for £675,269, and weaving machinery for £179,258. The British East Indies continued to be a good market for this branch of engineering, shipments thence during December being valued at £199,108. This was the most important outlet. Exports to Germany were also maintained at a satisfactory level and reached a total value of £130,390. The third largest individual market was the Netherlands with £80,754, followed by South America with £55,794, Japan with £44,982, France with £41,676, Australia with £38,441, the United States with £33,216, and China with £12,991, "other European countries" taking aggregate shipments amounting to £220,536. Exports to Russia during the month continued on an almost negligible scale, the total value being no more than £11,427.

A Satisfactory Year.

As has been said, the total export trade in textile machinery during the past twelve months cannot be regarded as unsatisfactory. The year's shipments of spinning and twisting machinery reached a total value of £8,817,904, and of weaving machinery £2,126,537. Unclassified textile machinery was exported to the value of £798,417, so that altogether textile machinists enjoyed an aggregate overseas trade during the twelve months valued at £11,742,858. This compares with £9,957,259 in 1926 and £12,156,983 in 1925. In spite of the fact that manufacturers of textile machinery suffered a severe blow as a result of the diplomatic rupture between this country and Russia in the first half of the year, with a consequent heavy decline in shipments thence during the last six months, the Russian market was responsible for imports of textile plant to the value of £1,000,404, which compares with £1,221,182 in the preceding year. Germany's imports, at £1,009,942, represented an important improvement compared with 1926, and a substantial increase was shown also in the case of the Netherlands, whose imports during the twelve months were valued at £1,005,838. The British East Indies was responsible for £2,354,352, against £2,104,401 in 1926, and "other European countries" for £2,403,272, compared with £1,883,162. In order of individual importance, the remaining overseas markets were South America, Japan, France, the United States, Australia, and China.

A Question of Fitness.

A case of interest to engineers generally received judgment in the Manchester County Court during the last few days, when a Manchester firm of engineers sought to terminate or reduce the compensation paid weekly to a workman. For the applicants it was explained that the respondent had been employed by them for a good many years as a borer, and was now fifty-three years of age. At the time of the accident, in January of last year, his wages were £3 2s. a week. In 1915 he lost two fingers on his right hand, and the result of the second accident was that he lost his index finger up to the joint, and had his little finger injured, both on his left hand. The respondent said he had been injured on numerous occasions as the result of the incapacity arising from the crippling of his right hand. He had lost all his confidence among machinery, and could not go back among it "if it meant saving his life." The reply to this, on behalf of the applicant firm, was that if the plea were successful 90 per cent. of the workmen's compensation cases in the future would set up the same plea. Whilst acknowledging that the respondent was one of the best type of workmen, it was urged that employers would be placed in an extremely difficult position if injured workmen, when offered fresh work, could turn it down again by merely refusing to try it. Judge T. B. Leigh, who heard the case, said he had listened to the respondent with great sympathy, and there was no doubt that he had developed a great aversion to machinery. Whilst he had no power to compel a man to undertake any work he thought the respondent was physically capable of doing the work the applicants had offered him. It was a difficult case, and he had come to the conclusion that the respondent was capable of earning wages in suitable employment. He estimated his earning capacity at 32s. a week, and therefore reduced the amount of compensation payable to 17s. 6d. a week.

Gasholder Explosion Enquiry.

The date of the official enquiry into the explosion which occurred last August at the Bradford-road Gasworks of the Manchester Corporation has been fixed for Thursday, February 2nd, to be held in Manchester.

Non-ferrous Metals.

Tin has again been the spectacular feature of the non-ferrous metals market during the past week. A further serious decline in values has been experienced, the fall since my last report being virtually on the same heavy scale as in the previous week. The primary cause of the slump must again be attributed to the statistical position, the market view being that future supplies of the metal, judging from current indications, will be greatly in excess of the demand, failing a material improvement in the latter from the existing level. If the steady decline that has occurred in this section of the market during the past four or five weeks is anything to go by, prospects are likely to be even more speculative than usual. After a slight early relapse copper pretty well recovered its position of a week ago, the difference at the time of writing being fractional. There has been a fair amount of buying interest in the standard metal, although refined descriptions have been rather quieter. The trade demand for lead had been on moderate lines, but values have finished up steady, and there has been no loss whatever on balance. The movement of spelter has been slow, and prices are slightly below the level of a week ago, although the difference in favour of the latter is of little importance.

Iron and Steel.

In spite of the fact that pig iron consumers on this market have been disposed to take a little more interest since my last report, nothing has occurred up to the present to warrant the hope that we are now on the eve of a fresh buying movement. It is, however, satisfactory to be able to report that the demand for foundry iron this week has been on a somewhat bigger scale than at any time since the market entered upon its seasonal quiet spell midway through December. The bulk of the recent business has been in respect of small or medium-sized parcels for delivery spread over a limited period, though some sellers have been in a position to report the booking of several contract orders to cover the prospective needs of buyers for the next two or three months. Generally speaking, little important alteration in prices has taken place, notwithstanding the fact that there is evidence of weak selling in isolated instances. Midland brands—Staffordshire and Derbyshire—are quoted for delivery Manchester or equal distance at about 72s. 6d. and 73s. per ton respectively, whilst Middlesbrough at 78s. 2d., Scottish at about 88s., and hematite at 85s. are steady and about unchanged. The demand for manufactured iron is slow, but prices are maintained at £10 per ton for Lancashire Crown bars and £9 10s. for second quality material.

Steel.

A moderate early delivery business continues to be transacted on the steel market, but there is little or no forward buying going on, and conditions are dull and present few interesting features. Boiler-plates continue to display signs of easiness, and current quotations for them are from £10 to £10 7s. 6d. per ton. Steel bars are in like case, and offers vary from £7 7s. 6d. up to £8 10s. per ton, according to size. Joists and sections and tank plates are, however, fully maintained at the fixed rates of £7 12s. 6d. and £8 7s. 6d. per ton. Except that German makers, for the time being, are reported to be less anxious to accept orders, the position of imported materials is much the same as it has been of late, and in the absence of any important buying values are largely nominal, although merchant stockholders continue to compete very keenly for any prospective business. Continental sheet bars for delivery to works in this area are quoted by the rolling mills at £5 2s. 6d. per ton, with billets at £5, steel bars at £5 17s. 6d., sections at £5 10s. to £5 12s. 6d., Siemens plates at £7 10s. to £7 12s. 6d., ordinary plates at £7 2s. 6d., and wire rods at about £6 7s. 6d. per ton.

BARROW-IN-FURNESS.

General Conditions.

There are just a few signs that the hematite pig iron trade of this district is improving. It is perhaps too early to build great hopes on these signs, but, nevertheless, they are welcomed, and there is just a possibility that the future will see better business. On home account there is a better inquiry, and there are even signs of orders being booked for forward delivery. At present the output is considerably restricted, two of the works being entirely closed down, whilst stocks are being cleared. With any improvement in the demand, these stocks will be reduced at a greater pace than occurred last month, and very soon we may hear of increased production. The local steel makers are taking good deliveries of iron, and this fact is helping to keep some of the furnaces going. Continental trade does not promise much, and the same remark applies to orders on American account. The iron ore trade is moderately active, but is confined mostly to local inquiries. There is a little ore going out of the district. The steel rail market is on the quiet side, and unless orders are booked within the next few weeks there may be a tailing off in production. Much regret is expressed locally at the South African order going to the Continent. A share of this order would have kept the Barrow rail mills busy until Easter. Hoops are experiencing a steady trade, largely on overseas account, and the outlook is good. Fuel is in steady demand, and shipbuilders and engineers are busy.

A Hydro-electric Station.

The Charcoal Iron Company, Ltd., of Backbarrow, North Lancashire, has erected a hydro-electric generating station at its works, the power being obtained from the Backbarrow Falls on the river Leven, adjoining. It expects to generate 700,000 units per annum for use in the works and for supplying the surrounding district with electricity for lighting purposes. The turbine was constructed by Gilbert Gilkes and Co., Ltd., of Kendal. The Barrow Corporation had a scheme for generating electricity from the Backbarrow Falls, but it was abandoned, having met with great opposition.

SHEFFIELD.

(From our own Correspondent.)

A Poor Beginning.

ALTHOUGH there are still hopes in many quarters that the present year's trade will show an improvement on last year's, it had not been anticipated that much revival would be apparent in January. It is well that no such anticipations were formed, for if they had been they would have led to nothing but disappointment. The year has, in fact, started very unsatisfactorily, not only on the heavy, but also on the light side of the steel trade. Taking the city generally, there is less work on hand at present than before the holidays. Both locally and in Lincolnshire the reports with regard to basic open-hearth steel are very unsatisfactory. There has been a further fall from even the low level of production which existed at the end of the old year, and there are more furnaces out of operation than at work, while orders and inquiries alike are very scarce. Prices of pig iron are easier, but there is no forward buying of this or any other raw material, and the market for steel scrap is very flat. The finished steel departments give a better account of themselves, but they are not well placed. The demand for special steels for the automobile industry continues to provide one of the best outlets for a large number of firms, but it is not as good as that of twelve months ago, although this is the busy season for the trade. There is a fair inquiry for tools of a general character, but prices are unsatisfactory. The file trade is still only moderate. The home market is taking a useful quantity of best quality small tools, but the export trade is slack, as it relates mostly to cheaper goods, many of which are supplied from Germany. Farm and garden tools are now being produced for the coming season, but it is hardly expected that trade will be brisk, as, owing to last year's comparative failure, large stocks remain in the hands of distributors.

Company Reorganisation.

A reassuring statement has been issued with regard to the firm of Jonas and Colver, Ltd., Novo Steel Works, Sheffield, the debenture holders of which have, as I reported last week, appointed a receiver. It is officially announced that the business is being carried on quite normally under the receiver, and there will be no interruption of its continuity. The receivership is regarded as a temporary matter to protect the assets of the business pending the conclusion of the negotiations which are now in progress for the reorganisation of its finances. The management adds that the turnover is not appreciably affected by the step which it has been found necessary to take, and there is every indication that the company retains the goodwill of its customers. In the meantime, the receiver has quite adequate resources to carry on the business. The number of employees of the firm is about 500. The Chancery Division has confirmed the reduction of the capital of Henry Bessemer and Co., Ltd., by writing off 13s. 4d. from each of the 233,500 issued ordinary shares, bringing them down to 6s. 8d. The company, whose business is now confined to the manufacture of tires, axles and locomotive crank axles, has suffered heavy losses during the last few years, but it is believed that last year produced a small profit.

Colliery Development.

The legislation of the past few years, with regard to the working facilities and support of mines, has again proved useful in enabling steps to be taken for the development of a number of small areas in the Doncaster district. Last week, the Railway and Canal Commission granted the application of the Askern Coal and Iron Company for authority to work a number of parcels of land, amounting altogether to 592 acres, in several parishes to the north-east of Doncaster. When the scheme first came before the Court in June last opposition was offered by the West Riding County Council and the Dun Drainage Board, on the ground of damage to drainage which might be done by the workings, as the area is a very low-lying one. Agreement has now been come to with these bodies, the colliery company having undertaken to provide a fund which will be available for compensation and the execution of remedial works.

Derbyshire Bridges.

Among the bridges which suffered severely from the Christmas floods was the new Leadmill Bridge over the river Derwent at Hathersage, which had been almost completed at a cost of £17,000. The Derbyshire county surveyor reports that the three main arches are substantially intact, but the small flood arch on the Grindleford side of the river is cracked. He proposes to form a pile dam round the piers, and pump out the water, if possible, to enable a proper inspection to be made. Until this can be done the necessary course of action cannot be decided upon. The main abutments have not been affected, and the settlement in the piers is a matter of a few inches. He found that the masonry in the spandrels and parapet had several open joints, and, as it would have to be rebuilt in any case, he has had the parapet taken down. The Bridges and Highways Committee of the Council has completed negotiations for the purchase of the land required for the widening of the Doe Lea Bridge, Staveley, and the county surveyor has been instructed to prepare plans and estimates for the widening of the Ashford bridges.

Leeds Water Developments.

Various extensions of the Leeds waterworks are in progress or in contemplation, for the purpose of improving the supply in districts on the outskirts of the city. The water engineering department of the Corporation has just finished the laying of a 12in. main from Headingly to Tinshill, and a 20in. main from Bramley reservoir to Whingate is nearly completed. The construction of a reinforced concrete reservoir at Middleton, to hold a million and a half gallons, is to be undertaken shortly. It will take the place of a small basin acquired from the Hunslet Rural Council, and will not only supply Middleton, but also meet the demands of Rothwell, which are increasing. Another reservoir is to be built at Tinshill. This will have a reinforced concrete roof, and a capacity of 1,000,000 gallons, and there is also to be an elevated reinforced concrete water tank holding 100,000 gallons. These works will meet the needs of Cookridge, Adel, Bramhope, Pool, Huby, and Weeton for the next thirty years, and will also secure ample supplies of filtered water for districts further away from the centre of the city.

A Large Sewerage Scheme.

The sinking of new collieries in the Mansfield district of Nottinghamshire has led to great building activity at Clipstone, Edwinstowe, and Forest Town, with the result that further sewerage facilities are needed. The Southwell Rural, Mansfield Woodhouse Urban, and Mansfield Town Councils are proposing to carry out a joint scheme on a large scale, the estimated cost being £43,400. The necessary Ministry of Health inquiry has been held with regard to the applications for borrowing powers. The Southwell Council is asking for a loan of £32,000, Mansfield Council for £3400, and Woodhouse Council for £8100.

Other Municipal Proposals.

Barnsley Town Council has adopted a scheme for the building of an abattoir at a cost of £33,250, and is also proposing to spend £7344 on the extension of electricity distributing mains and public lighting mains. The widening of a considerable length of road between Thornaby and Middlesbrough is proposed by the Thornaby Corporation. The estimated cost is £33,800, and the Corporation has decided to apply to the Ministry of Transport and the North Riding County Council for approval, and also for a contribution from each of half the cost. A scheme for the conversion of the existing single tram track into a double track is being carried out by the Stockton and Thornaby Joint Tramways Committee, which has decided to spend a further sum of £14,264, which will bring the total cost of the work up to £48,064.

An Appointment.

Mr. Frank Biggin, who has been a director of the Brightside Foundry and Engineering Company, Ltd., Sheffield, since 1918, has now been appointed joint managing director with Mr. F. W. Firth, chairman of the company. Mr. Biggin commenced his business career with the firm forty-five years ago, at the age of fifteen, and has been largely responsible for the development of the heating and ventilating branch of the business. He has been President of the National Association of Heating and Ventilating Engineers, as well as of the Sheffield and District Association, and is a member of several other technical societies.

NORTH OF ENGLAND.

(From our own Correspondent.)

Coal Board Fails to Agree.

THE District Board for the coal-mining industry of Durham having failed to agree this week over the proposed variations in the minimum percentage addition to basis rates and the subsistence wage, the independent chairman, Sir William Plender, has been called upon to arbitrate upon the matter. The county agreement determines that his decision shall be final and binding upon both parties. The cost of producing coal in the county is far above what the coal yields in the open market. Durham produces nearly three-quarters of a million tons of coal per week, and employs about 120,000 men and boys at the pits. It could produce more coal were it not that many pits are closed and many thousands of miners are out of work. Some of the older pits have been unable to continue the uneconomic struggle. When the strike ended and fresh agreements were drawn up in all the coalfields the Durham County agreement provided that the men should receive 89 per cent. addition to basis wages. The hope then was that the county might be able to do it, but over twelve months have slipped by, and it has never been able to pay the percentage, and so the deficiency has grown from month to month until now it amounts to over two million pounds. The first month after the agreement came into operation it allowed out of the ascertainment of proceeds and costs only 79·64 per cent. on the basis, a drop of ten points, and month by month subsequently the percentage went down until in the current month there was available only as much as would pay 33·49 per cent. on the basis, although the owners have had to continue paying the 89 per cent. as laid down by the agreement. This shows a gulf of 47·89 per cent. as between costs and proceeds, and how it is to be bridged is a vital issue at this time.

Cleveland Iron Trade.

Business in the Cleveland pig iron trade is still quiet, but negotiations for spring supplies should soon enliven the market. Prices have reached rock bottom, but some consumers accustomed to buying on a falling market appear to be exercising a little restraint that the situation from a buyer's point of view may hardly be said to warrant at the moment. Indeed, any possible change is regarded as likely to be in the opposite direction because a fair amount of trade in pig iron is still passing, and makers steadily maintain that prices are unremunerative. Conditions on the Continent have been changing slightly in favour of British competition in markets abroad, and hope is entertained that Cleveland will secure a fair share of the trade that comes to this country. Production of Cleveland iron is promptly absorbed, chiefly by local

foundries and steelworks. Consumers in other home areas are inclined to discuss business more freely, but trade with Scotland still languishes. Quotations are unchanged, No. 1 Cleveland foundry iron being 67s. 6d., No. 3 G.M.B., 65s.; No. 4 foundry, 64s.; and No. 4 forge, 63s. 6d. per ton.

Hematite Pig Iron.

Recognised market rates for East Coast hematite pig iron are stated to be well below cost of production, but while makers are less disposed to cut prices, they are still ready to book orders at round about quotations for mixed numbers on the basis of 70s. Ordinary brands are little inquired for, consumers, as a rule, stipulating for iron to special analysis. An encouraging feature of the market at the moment is the number of inquiries circulating on continental account.

Ironmaking Materials.

Large imports of foreign ore continue to be made under old contracts, but new transactions are rarely heard of. Best Rubio ore is nominal at 21s. per ton c.i.f. Tees. Sales of Durham blast-furnace coke continue few and small, producers failing to tempt ironmasters to enter into extensive contracts at low figures. Good average qualities are quoted at 17s. 6d. per ton delivered at the works.

Manufactured Iron and Steel.

The demand for manufactured iron and steel is broadening out considerably, with plenty of inquiry circulating both for home and export, and the position is most favourable. Generally the impression prevails that the immediate future should see a big expansion in the steel trade.

The Coal Trade.

There is a generally good tone in all sections of the Northern coal trade. Most of the favourite brands are fully booked up, and buyers cannot get additional turns, and for any small parcels for filling up purposes full top prices are obtainable. The outlook for February so far does not point to any activity, but fitters maintain that there is a briak inquiry, but buyers are only operating from hand to mouth, and that as the end of the month approaches business will again become of substantial dimensions. In many cases holders adhere firmly to recent prices, but through second hands small discounts are workable. The concessions, however, do not exceed more than odd coppers. Northumberland steam coals have a healthy appearance for the next two or three weeks. Pits, however, will do well to dispose of their output in these days of keen competition abroad, even if prices are to remain as they are. Freights have a hardening tendency, and this is not favourable for low c.i.f. contracts recently made. Direct the price of best steams is 14s., and in second hands the position is more than maintained. Steam smalls of all kinds are steady, and there are hopes of more trade coming. Best smalls are quoted up to 10s. 6d., and second grades 8s. 6d. to 9s. Durham gas coals are favourably placed with immediate trade and do not deviate from current quotations, and coking coals remain in brisk request for foreign shipment. Some producers of coking fuel have more inquiries than they can cope with. The coke trade continues on active lines, but supplies are scarce. Prices rule steady at 22s. 6d. to 23s. 6d. for gas coke; 25s. to 30s. for beehive; 17s. 6d. to 18s. 6d. for patent oven; and 22s. to 24s. for superior makes.

Tyne Yard's Big Contract.

A big order has been booked by Swan, Hunter and Wigham Richardson, Ltd., for a train-carrying vessel for an American firm. The vessel will carry railway cars from New Orleans to Havana, in Cuba, and will be 420ft. long, with a deadweight carrying capacity of 8000 tons. The Wallsend Slipway and Engineering Company will provide the engines, which will be of the ordinary steam type. The cost of the vessel will be £130,000, and it will inaugurate a new service for the transit of trains from the United States to Cuba. It is calculated that the construction of the vessel will provide work for over ten months, though this will not necessitate the employment of more men at the yard.

SCOTLAND.

(From our own Correspondent.)

More Confidence.

RESUMPTION of work is now general, and so far there does not appear to be much change, if any, from conditions obtaining before the holidays. Demands on the whole are light, and prospects do not seem particularly bright, but evidence is not lacking of a feeling of confidence existing in certain departments. Closer co-operation between employer and employee is a pleasing possibility, which it is fervently hoped will develop into a certainty. With a probable shortage of skilled labour in some departments, due largely, if not wholly, to emigration, co-operation would be a boon, and there is little doubt that the recent trend of affairs in labour circles has had not a little to do with the establishment of the increased confidence already referred to. Hopes have so often been dashed to the ground in the past that many are chary of passing any opinion, but are, nevertheless, hopeful that the dawn of a better spirit in industry is not far distant.

Steel.

So far as heavy steel is concerned, the market is not particularly bright at present. Most producers have work for a week or two ahead. Better inquiries from the shipyards would be appreciated. There are now signs of improvement in demand from other home consumers, but shipbuilding requirements are the principal source of disposal. There is still a possibility that a scheme to centralise export sales may be formulated. Prices are unchanged.

Steel Sheets.

The all-round demand for steel sheets is somewhat disappointing, more especially as regards export, and prices are comparatively easy.

Iron.

Bar iron makers have nothing fresh to report. The accumulation of orders over the holidays was light, and inquiries are unsatisfactory. The re-rolled steel bar section is somewhat better off meanwhile, but can hardly be termed active. Home prices are unchanged, but a good export order might be done under the nominal quotations of £10 per ton for bar iron and £7 per ton for re-rolled steel.

Pig Iron.

Pig iron has a very poor market. The number of furnaces in blast has been reduced by about ten, but there is as yet no indication that present outputs will be in any way taxed to meet requirements. Quotations are weak, but unchanged.

Exports and Imports.

Arrivals of iron ore at Glasgow showed a large increase, the total being 13,500 tons. Iron and steel to the amount of 1200 tons were also unloaded, and 1500 tons of manganese ore from India. Exports were delayed by the holidays, and only some 700 tons of steel and iron products were dispatched.

Coal.

The coal market maintains a firm attitude. Fresh inquiries are comparatively light, but many collieries have fair bookings over January, and sales are not pressed. Some sizes of nuts were affected by interrupted shipments, owing to the Thames flooding, but smalls generally are none too plentiful. Lanarkshire splints are very firm, and the position of ells has improved, owing partly to increased land sales. Lothians steams are moving steadily, and best Fifeshire steams are firm. Aggregate shipments amounted to 196,289 tons, against 132,371 tons in the preceding week, and 217,859 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

THERE was a slight improvement in the coal export trade last week as revealed in the returns, which showed that the total was close on 400,000 tons, as compared with just over 374,000 tons for the previous week. The anthracite trade continues to be very quiet, and there is no doubt that shipments of steam coal were detrimentally affected by the shortage of tonnage. Even now supplies to hand are unequal to requirements, as will be seen from the fact that on Tuesday there were thirty-nine idle loading appliances at the various docks. Steamers have been considerably delayed, and in many cases damaged, by the recent bad weather, and this has inconvenienced collieries which looked forward to their prompt arrival to lift coals and keep the pits working. Coasting vessels have suffered considerably, and cases have been reported in which small steamers have taken ten days to a fortnight to do a voyage which normally takes only thirty-six hours. Although it cannot really be said that the steam coal trade is appreciably better, so far as values are concerned, there is a feeling that there is a firmer bottom to the market. No new contracts of importance have been entered into, although it is reported that the Lloyd Braziliero have purchased 25,000 tons of Welsh coals consisting of two-thirds large and one-third smalls, and that one of the Spanish railways is inquiring for prices for 13,000 tons of large coals for delivery over the next three months.

Continental Barriers.

Reference was recently made to the report that the Italian Government has arranged with Germany to take an increased quantity of reparation coals from Germany, and the news caused no little amount of anxiety to exporters and coalowners in this district. Information which has now been published shows that the supply of Reparation coals to Italy by Germany is now fixed by commercial contract in accordance with quarterly programmes, which are approved by the Reparations Commission, and according to the current programmes the quantity to be taken during the present month amounts to the extraordinary figure of 605,000 tons, which compares with 375,000 tons for December. This is a very serious matter, as on this basis it means an annual total of 7¼ million tons of German coals, with the probability that the trade of Italy with this country will be detrimentally affected to the extent of a further loss of about 3 million tons per annum. The policy of Italy is furthermore disclosed by a communication issued by a new coal-distributing organisation established in Milan, called the Azienda Nazionale Consumatori Carboni S.A., which is under the direct control of the Italian Government. This communication is issued to Italian consumers of coal, who are informed that they have instructions from their Government to place with consumers Reparation coals which they can put at their disposal at advantageous conditions, both of price and payment. The communication adds that the firm is acting under the direct control of the Government authorities, and that therefore Italian industry is morally engaged to give preference in its purchases to the coals which the Government has to take as Reparation. Coal exporters in this district are also feeling anything but comfortable so far as exports to France are concerned. It is quite true that the French Government has withdrawn the licence system, but the proposal is on foot to increase the Customs duties on various commodities, including coal. The duty at present is 2f., but what the proposed increase is to be has not yet been disclosed.

Trade of South Wales.

Returns now show that 22,365,226 tons of Welsh coal were shipped abroad last year as cargo, which compares with 9,222,227 tons for the year 1926, and 21,183,117 tons in 1925, while the figure for 1913 was 29,540,510 tons. The 1925 figures were exceeded by more than 1,000,000 tons, but 1925 was a bad year, and the total of last year shows a loss of more than 7,000,000 tons as compared with 1913.

Coalfield Items.

Reference was made to the fact that there was a danger of the Bedwas collieries being closed, but as the result of negotiations between the workmen's leaders and the management, this has been avoided. Work is to be continued on a restricted scale and on day-to-day contracts, but about 500 men will not be able to get employment. There are also hopes of the Beynon Colliery, Blaina, being reopened after being closed down for many weeks past. Normally, 1500 workmen are engaged. It is understood that the Ebbw Vale Company has made an offer to the miners.

Iron and Steel Trades.

It is reported that the largest of the Blaenavon Company's blast-furnaces is shortly to be blown in. Except for very short intervals the furnace has been idle for a number of years. Reports show that the tin-plate trade is more active. For the first time for a considerable period, all the tin-plate works in the Swansea area are engaged, though perhaps not to the full extent of their capacity. The improvement is attributed to the introduction of the stabilisation scheme.

Current Business.

There is no outward evidence of an improvement in the steam coal market, operations from day to day being comparatively quiet. Yet at the same time exporters appear to have rather more orders, and certainly they are finding it increasingly difficult to obtain the tonnage they require, with the consequence that freight rates are better. This is especially the case for the Mediterranean ports, and particularly for the upper ports, but unfortunately a substantially greater inquiry for coals is necessary for coal values to be advantageously affected. Both large and small coals are round about recent quotations, but sized coals are, if anything, a shade firmer. Patent fuel and coke display no alteration, and pitwood is a trifle steadier.

VACANCIES FOR AIRCRAFT APPRENTICES.—The Air Ministry announces that 600 aircraft apprentices, between the ages of fifteen and seventeen, are required by the Royal Air Force for entry into the Schools of Technical Training at Halton, Bucks., and at Flowerdown, near Winchester. They will be enlisted as the result of an open competition and of a limited competition held by the Civil Service Commissioners and the Air Ministry respectively. Successful candidates will be required to complete a period of twelve years' regular Air Force service from the age of eighteen, in addition to the training period. At the age of thirty they may return to civil life or may be permitted to re-engage to complete time for pension. Full information regarding the aircraft apprentice scheme can be obtained on application to the Royal Air Force, Gwydyr House, Whitehall, London, S.W. 1.

INSTITUTION OF ELECTRICAL ENGINEERS.—The annual dinner of the North-Western Section of the Institution of Electrical Engineers was held on Tuesday night last, at the Midland Hotel, Manchester, and was very well attended. Mr. A. B. Mallinson, M.I. Mech. E., chairman of the section, presided. The toasts were commendably few. That of the "Cities and Trade of Manchester and Salford" was proposed, in a very happy speech, by Mr. B. Mouat Jones, D.S.O., principal of the Manchester College of Technology, and was responded to by the Lord Mayor of Manchester—Councillor W. Davy. The toast of "The Institution of Electrical Engineers," was proposed by Mr. J. R. Clynes, who spoke of the state of the home industries, and said that he was looking forward to an even better year in 1928 than that just passed, which, he said, was free from trade disturbances, there being less cessation of work than in any of the past fifty years. Speaking of the conferences which were being held with regard to industrial relations, Mr. Clynes said that the outlook was very hopeful. The President of the Institution of Electrical Engineers, Mr. Archibald Page, replied to this toast, and paid compliments to Lancashire and Manchester for the parts which their engineers had played with regard to electricity supply. The Barton Station was, he said, easily the most efficient in the country, and its achievements compared very favourably with those of the best mammoth stations in America. The toast of "The Guests" was proposed by the Chairman, and responded to by Mr. Douglas Miller, High Master of the Manchester Grammar School. Not the least enjoyable feature of the evening was the musical programme, which was on a higher plane than is customary on such occasions.

DIESEL ENGINE USERS ASSOCIATION.—According to the secretarial statement for 1927, the activity of the Diesel Engine Users Association is reflected in the continuous growth of membership. Forty-seven new members and subscribers were elected in 1927. The total membership of the Association at the present time, including members and subscribers, is 472, of whom over 100 are resident in British Dominions and in foreign countries. Two of the earliest members, both interested in electricity supply undertakings, are resigning their membership at the end of the current year. The reason given is that they are now taking a supply of electricity in bulk and are no longer connected with the working of Diesel engine plant. In view of the new arrangements which are being made for the supply of electricity in London, the Carels Diesel engine plant at Chelsea is to be closed down at an early date, and Mr. Percy Still, who has acted as honorary secretary and joint honorary secretary of the Association since 1913, will then cease to be a Diesel engine user. The Chelsea plant has been in regular use since it was first installed in 1913, and has given excellent service throughout the period. Due care was taken in providing suitable foundations for the plant when it was erected, and although it is situated in a closely built and important residential district there has at no time been any trouble from transmission of vibration to adjoining property. During the year ended December 31st, 1926, this plant generated over 1,000,000 units at a total works cost of ·707d. per unit with an annual plant load factor of 22·6 per cent., and the efficiency is practically as good as it was when the plant was first installed. If due regard is paid to the maintenance of the plant, as has been done in the past, there would appear to be no reason why it should not continue to operate satisfactorily for a further long number of years.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	18/6 to 21/–
(1) Spanish	18/6 to 21/–
(1) N. African	18/6 to 21/–
N.E. COAST—	
Native	18/– to 21/–
Foreign (c.i.f.)	21/–

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 14 0	—
No. 1 Foundry	3 15 0	—
No. 3 Foundry	3 10 0	—
N.E. COAST—		
Hematite Mixed Nos.	3 10 0	3 10 0
No. 1	3 10 6	3 10 6
Cleveland—		
No. 1	3 7 6	3 7 6
Silicious Iron	3 7 6	3 7 6
No. 3 G.M.B.	3 5 0	3 5 0
No. 4 Foundry	3 4 0	3 4 0
No. 4 Forge	3 3 6	3 3 6
Mottled	3 3 0	3 3 0
White	3 3 0	3 3 0
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	—	—
,, ,, Foundry	3 4 6 to 3 6 0	—
(3) Northampton—		
Foundry No. 3	3 0 0 to 3 1 0	—
Forge	2 14 0	—
(3) Derbyshire—		
No. 3 Foundry	3 4 0 to 3 6 0	—
Forge	2 19 0	—
(3) Lincolnshire—		
No. 3 Foundry	3 4 0 to 3 5 0	—
No. 4 Forge	3 2 6	—
Basic	3 2 6	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 2 0 (a) / 4 5 0 (b) / 4 8 6 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 5 0	10 0 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 5 0	—
Common Bars	10 5 0	—
Best Bars	10 15 0	—
LANCS.—		
Crown Bars	10 0 0	—
Second Quality Bars	9 10 0	—
Hoops	12 10 0	—
S. YORKS.—		
Crown Bars	10 10 0	—
Best Bars	11 15 0	—
Hoops	12 10 0	—
MIDLANDS—		
Crown Bars	9 2 6 to 10 5 0	—
Marked Bars (Staffs.)	12 10 0	—
Nut and Bolt Bars	9 0 0	—
Gas Tube Strip	11 10 0	—

STEEL. (d)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	10 10 0	10 10 0
Ship Plates, ½in. and up	8 2 6	7 12 6
Sections	7 12 6	7 2 6
Steel Sheets, ¼in.	8 17 6	8 15 0
Sheets (Gal. Cor. 24 B.G.)	13 12 6	13 7 6

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 2 6	—
Angles	7 12 6	—
Boiler Plates	12 10 0	—
Joists	7 12 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 2 6	—
Soft Billets	7 5 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	7 10 0 to 10 0 0	—
MANCHESTER—		
Bars (Round)	8 10 0	—
,, (Small Round)	7 10 0	—
Hoops (Baling)	10 5 0	10 0 0
,, (Soft Steel)	9 0 0	8 15 0
Plates	8 7 6	—
,, (Lancs. Boiler)	10 5 0	—
SHEFFIELD—		
Siemens Acid Billets	10 0 0	—
Hard Basic	7 12 6 to 8 2 6	—
Intermediate Basic	7 10 0	—
Soft Basic	6 10 0	—
Hoops	10 0 0 to 10 10 0	—
Soft Wire Rods	9 0 0	—
MIDLANDS—		
Small Rolled Bars	7 7 6 to 8 0 0	—
Billets and Sheet Bars	6 0 0 to 6 5 0	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	—
Galv. Sheets, f.o.b. L'pool	13 0 0 to 13 5 0	—
Angles	7 12 6	—
Joists	7 12 6	—
Tees	8 12 6	—
Bridge and Tank Plates	8 7 6	—
Boiler Plates	11 0 0 to 11 10 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	18/– to 18/3
Block Tin (cash)	247 0 0
,, (three months)	246 5 0
Copper (cash)	61 10 0
,, (three months)	61 12 6
Spanish Lead (cash)	21 13 9
,, (three months)	22 5 0
Spelter (cash)	25 18 9
,, (three months)	26 1 3
MANCHESTER—	
Copper, Best Selected Ingots	66 12 6
,, Electrolytic	67 5 0
,, Strong Sheets	92 0 0
,, Tubes (Basis Price), lb.	0 1 0½
Brass Tubes (Basis Price), lb.	0 0 11½
,, Condenser, lb.	0 1 1½
Lead, English	23 7 6
,, Foreign	22 7 6
Spelter	26 2 6
Aluminium (per ton)	£107

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/8 per lb.	
Ferro Tungsten	1/3 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 0 0	7/6
,, ,, 6 p.c. to 8 p.c. ,,	£22 17 6	7/3
,, ,, 8 p.c. to 10 p.c. ,,	£22 10 0	6/6
,, ,, Specially refined		
,, ,, Max. 2 p.c. carbon	£36 0 0	11/6
,, ,, ,, 1 p.c. carbon	£41 10 0	15/–
,, ,, ,, 0·70 p.c. carbon	£53 0 0	17/6
,, ,, ,, carbon free	1/4 per lb.	
Metallic Chromium	3/– per lb.	
Ferro Manganese (per ton)	£13 0 0 for home, £12 for export	
,, Silicon, 45 p.c. to 50 p.c.	£12 15 0 scale 5/– per unit	
,, ,, 75 p.c.	£20 5 0 scale 6/– per unit	
,, Vanadium	14/3 per lb.	
,, Molybdenum	5/– per lb.	
,, Titanium (carbon free)	0/11½ per lb.	
Nickel (per ton)	£175	
Ferro-Cobalt	9/3 per lb.	

FUELS.

SCOTLAND.
(Prices not stable.)

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	14/3
,, ,, Ell	15/6
,, ,, Splint	17/6 to 18/–
,, ,, Trebles	14/9
,, ,, Doubles	14/3
,, ,, Singles	11/6
AYRSHIRE—	
(f.o.b. Ports)—Steam	13/3
,, ,, Jewel	15/6
,, ,, Trebles	14/6
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	12/– to 13/3
Screened Navigation	18/–
Trebles	14/9 to 16/–
Doubles	14/3
Singles	11/9
LOTHIANS—	
(f.o.b. Leith)—Best Steam	12/9
Secondary Steam	12/3
Trebles	14/6
Doubles	14/6
Singles	11/9

ENGLAND.

(8) N.W. COAST—	
Steams	24/– to 25/–
Household	37/6 to 50/–
Coke	23/6
NORTHUMBERLAND—	
Best Steams	13/9 to 14/–
Second Steams	12/6 to 13/–
Steam Smalls	10/–
Unscreened	13/– to 13/6
Household	21/– to 27/–
DURHAM—	
Best Gas	15/6
Second	13/9 to 14/–
Household	21/– to 27/–
Foundry Coke	19/– to 26/–
SHEFFIELD—	Inland.
Best Hand-picked Branch	27/6 to 29/6 —
Derbyshire Best Bright House	20/6 to 21/6 —
Best House Coal	19/– to 20/6 —
Screened House Coal	16/– to 17/6 —
,, ,, Nuts	15/– to 16/– —
Yorkshire Hards	14/6 to 15/6 —
Derbyshire Hards	14/– to 15/6 —
Rough Slacks	8/6 to 9/6 —
Nutty Slacks	6/– to 7/– —
Smalls	3/– to 4/6 —
Blast-furnace Coke (Inland)	13/– at ovens —
Furnace and Foundry Coke (Export), f.o.b.	18/– to 18/6

(9) SOUTH WALES.

CARDIFF— Steam Coals :	
Best Smokeless Large	19/– to 19/6
Second Smokeless Large	18/6 to 19/–
Best Dry Large	18/3 to 18/9
Ordinary Dry Large	17/6 to 18/–
Best Black Vein Large	17/3 to 17/6
Western Valley Large	17/– to 17/3
Best Eastern Valley Large	17/– to 17/3
Ordinary Eastern Valley Large	16/6 to 17/–
Best Steam Smalls	12/6 to 13/–
Ordinary Smalls	11/– to 12/6
Washed Nuts	18/– to 22/6
No. 3 Rhondda Large	19/6 to 20/–
,, ,, Smalls	14/9 to 15/3
No. 2 ,, Large	16/– to 16/6
,, ,, Through	14/6 to 15/6
,, ,, Smalls	12/6 to 13/6
Foundry Coke (export)	30/– to 35/–
Furnace Coke (export)	27/6 to 30/–
Patent Fuel	22/6 to 24/–
Pitwood (ex ship)	28/– to 28/6
SWANSEA— Anthracite Coals :	
Best Big Vein Large	30/– to 32/6
Seconds	25/6 to 29/–
Red Vein	20/6 to 25/–
Machine-made Cobbles	35/– to 40/–
Nuts	38/6 to 42/6
Beans	22/6 to 27/6
Peas	17/– to 18/6
Breaker Duff	8/6 to 9/–
Rubbly Culm	8/– to 8/6
Steam Coals :	
Large	17/6 to 18/6
Seconds	16/– to 17/–
Smalls	10/– to 11/–
Cargo Through	15/– to 16/–

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/– extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. (d) Rebate 7/6 joists and 5/– all other materials if home consumers confine purchases solely to British products.

French Engineering Notes.

(From our Correspondent in Paris.)

Harbours and Waterways.

THE problem of German reparations threatens to assume a somewhat difficult phase. Until a few years ago the French Government hesitated to make full use of its right to accept reparations in the form of manufactured materials on account of the effect it was feared the importation of German manufactures would exercise upon home industries. Under the Dawes scheme it became clear that unless materials and manufactures were accepted in payment there was very little chance of getting much else, and the Government has therefore taken ample advantage of reparations for the carrying out of public works which it would otherwise be impossible to execute. During the present year the Minister of Public Works proposes to carry out an extensive programme of harbour and waterway improvements, for which he is now seeking parliamentary sanction. For harbour improvements it is intended to require Germany to supply material to the value of 858,500,000f., while the German contribution to the inland waterway improvements, in the form of material, will be 100,000,000f. It is hoped to obtain from Germany a 25,000-ton floating dock for Havre. The 10,000-ton floating dock recently sent from Germany to Rouen has now been put into service. The difficulty over this question of reparations lies in the fact that the Germans are showing an increasing reluctance to carry out their engagements under the Dawes scheme on the ground that the country cannot support such a crushing burden. So long as only a moderate amount of material was required for reparations, to supply it actually helped to produce an industrial activity which was generally beneficial to the country; but, when the quantity of goods required more than counterbalances the benefits accruing from the industrial activity in the form of employment and wages, there can only be an impoverishment. A characteristic example is the supplying of continuous brakes for goods trains by Kunze-Knorr, of Berlin. The Germans have always affirmed that they were to provide Kunze-Knorr brakes to the French Government, while the Westinghouse Company would supply its own, the two being interchangeable; but it is now stated that the German company will have to supply Westinghouse brakes under licence. That will deprive them of every future advantage they would otherwise possess in providing brakes for reparations, notably in supplying replacements. The German opposition to reparations is therefore steadily growing.

The Trans-Saharan Railway.

The first step towards the construction of the railway across the desert of Sahara has been taken by the Government deciding to carry out the preliminary surveys at a cost of twelve and a-half million francs. This is the result of the persistent efforts which have been made by the Trans-Saharan Committee, an influential private body, to bring home to all classes of the community the advantages of connecting up North Africa with the Niger Valley. The undertaking appeals strongly to the public because it offers the only really effective means of linking up the vast African Empire with the Mother Country. Instead of entrusting the preliminary survey to a private company, as was originally intended, the Government has decided to form a Trans-Saharan Office, which will group engineering, financial and other experts appointed by the State, and it is expected that all details will be completed in time to permit of the Office starting work in October next and presenting its report six months later. So much has already been done in the way of surveying different routes across the desert that the Office will have plenty of data to work upon, and should the report be favourable the Government will place the construction and working of the line in the hands of a company which will probably be formed by the leading railways. About one-third of the capital for the preliminary survey will be provided by the State and the remainder will be contributed by Tunis, Algeria, Morocco, and West Africa and by the P.L.M., Paris-Orleans, and Midi companies.

Automatic Couplings.

The periodical resolutions of parliamentary groups inviting the Government to equip all railway coaches and wagons with automatic couplings, have only so far had the result of showing that much will yet have to be done before it is possible to adopt these couplings generally. With the aid of credits voted by Parliament, tests were begun as far back as 1906, when preliminary experiments were carried out with the Boirault coupling, which was subsequently adopted on some of the electric trains. Further trials were held in 1920, when it was found that no system of coupling fulfilled all conditions, although the Boirault and the Henricot, a Belgian apparatus, were selected for future experiments, which are being continued on the State and other railways. Meanwhile, another Bill was introduced into Parliament authorising the equipment of railway coaches with automatic couplings, and it was approved of by the Committee of Public Works as well as by the Financial Commission. Both, however, considered that it was quite impossible to effect the transformation at once, on account mainly of the cost, which would amount to something like 2500 million francs, while it is regarded as necessary, before definitely selecting some type, to continue the trials through a very severe winter in order to see whether the conditions then prevailing would affect the working of the couplings. Again, the wagons themselves are not adapted for the immediate fitting of automatic couplings, and it is argued that the use of such couplings can only follow the equipment of goods trains with continuous brakes, which will take at least six years to complete at a cost of 1500 million francs. The technical commissions therefore recommend that, in the Bill to be presented to Parliament, the automatic coupling programme should be made conditional on the execution of the programme for equipping goods trains with continuous brakes and that 1938 should be fixed as the date when the necessary transformation should be made.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

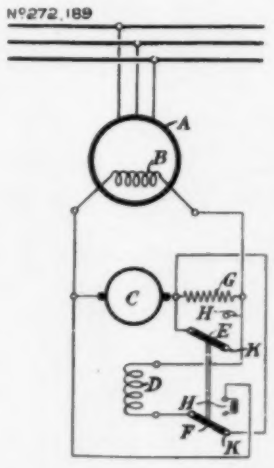
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

DYNAMOS AND MOTORS.

272,189. May 19th, 1927.—METHOD OF RAPIDLY DE-EXCITING DYNAMO-ELECTRIC MACHINES, Albert Levy Mond, of 19, Southampton-buildings, Chancery-lane, London, W.C. 2.

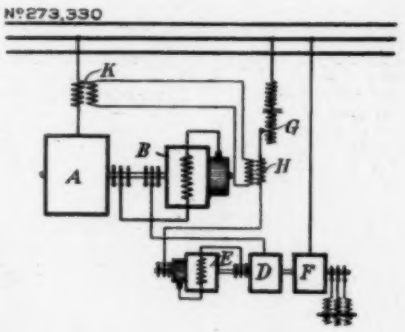
This invention relates to a method of rapidly de-exciting dynamo-electric machines, such as generators or motors. In the drawing, A indicates the generator; B the exciter winding of the generator; C the armature of the exciter machine; D the exciter winding of the exciting machine; E and F indicate two mechanically coupled switches adapted to effect the change-over of the self-excited shunt machine into a series exciter machine; and G is a resistance arranged in parallel with the winding D. During normal operation of the generator the



switches E and F are in the position H. The resistance G is then short-circuited, and the exciter field D is excited normally through the brushes of the armature C. When the generator suffers any damage, both switches E and F are switched over into the position indicated by K, with the result that the connections of the shunt exciter machine are converted into those of a series exciter machine, the resistance G being connected in parallel with the series exciter winding. It is known that series-wound machines having a field winding bridged by an ohmic resistance form an oscillatory system, and in the invention these oscillations are employed to effect a complete de-excitation of the generator.—*December 8th*, 1927.

273,330. June 27th, 1927.—IMPROVED MEANS FOR EXCITING CASCADED COMMUTATOR MACHINES WITH THE SUPPLY-CIRCUIT FREQUENCY, Siemens-Schuckertwerke Gesellschaft mit beschränkter Haftung, of Berlin-Siemensstadt, Germany.

A asynchronous main machine A is mechanically coupled to a commutator machine B, which is provided with a compensation winding and is excited through slip rings with a frequency of the supply circuit. The set for the excitation of the commutator machine comprises an asynchronous generator D, a commutator machine E, in the secondary circuit of the asynchronous generator, and the asynchronous driving motor F. As the commutator machine of the asynchronous generator is excited in the rotor with the frequency of the supply circuit through a regulating transformer G, the asynchronous generator D will also give the supply circuit frequency required for the excitation of the commutator machine B. The value and the

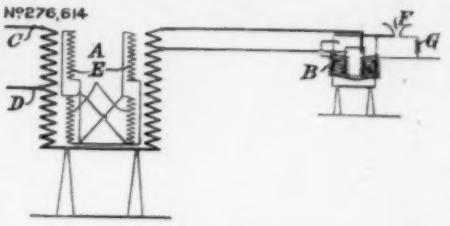


phase of the excitation of the commutator machine B can be controlled by the adjustment of the regulating transformer G, in the desired direction. The arrangement also has the advantage that the output or power to be controlled at the regulating transformer is very small. The transformer G need supply only the excitation energy of the commutator machine E. The excitation output of the commutator machine B amounts to about 30 per cent. of the total output of the machine. In the same way, the output of the commutator machine E amounts to about 30 per cent. of the output of the generator D; that is to say, to about 10 per cent. of the output of the commutator machine B. The output to be supplied by the transformer G amounts then to only 30 per cent. of the output of the commutator machine E, or to, say, 3 per cent. of the output of the machine B. If the commutator machine E is built as an ordinary frequency transformer, without the compensation winding, then, of course, the output in the transformer G will be increased, but it will still be very small. The regulating set has a compounding device for the purpose of controlling the number of revolutions of the main machine. The speed can, for instance, be reduced in order to render operative the fly-wheel masses coupled to the machine A. For this purpose a current transformer H is fed by a current transformer K in the primary circuit of the machine A.—*December 8th*, 1927.

TRANSFORMERS AND CONVERTERS.

276,614. November 23rd, 1926.—IMPROVEMENTS IN OR RELATING TO PROTECTIVE APPLIANCES FOR HIGH-TENSION TRANSFORMERS, Emil Haefely et Cie, A.G., of Lehenmattweg 353, Basle, Switzerland.

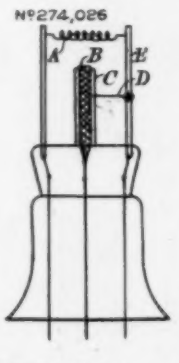
The invention is exemplified in the accompanying drawing, in which the high-tension transformer to be protected is marked A and a protective transformer is shown at B. The primary winding C D of the main transformer is in series with the secondary winding at the point D as in the well-known auto transformer connection. The protective transformer B, which constitutes an independent and distinct unit, is of the usual design, except that it is designed for a small percentage of the voltage of the transformer to be protected. It can also be pro-



vided with compensating windings in the same way as the windings E of the transformer A. The impedance of these compensating windings causes the highest possible damping effect upon surges. The exciting winding of the protective transformer B is connected to a part of the secondary winding structure of the high-tension transformer A and the potential difference between the primary and secondary windings of the additional transformer is kept within low limits. This allows the additional transformer to be constructed with a large amount of insulation, so that it may deal with surges without any harmful stresses. The secondary winding or other part of the protective transformer B can be protected by means of a spark gap F, with or without a damping resistance G.—*December 15th*, 1927.

ELECTRICAL APPLIANCES.

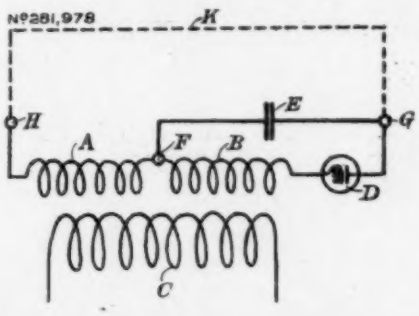
274,026. February 16th, 1927.—INCANDESCENT CATHODE RECTIFIERS, Friedrich Meyer, Hans-Joachim Spanner, and Carl von Wedel, all of Scheiblerstrasse 21, Berlin-Baumschulenweg, Germany.



A rectifier constructed in accordance with this invention has an incandescent low-temperature emitting cathode A in a large gas space, while the anode is in the form of a thin rod B surrounded by a small cylinder of metal C. The distance between the metal cylinder C and the anode rod B is made equal to or slightly greater than the mean free path of the gas. The small cylinder C is directly connected by means of the wire D and the cathode support E with the cathode A. A rectifier of this type will stand against a back current discharge of from 1000 to 500 volts, according to the gas and the spacing employed. The arrangement is especially suitable for the construction of rectifiers with multiple cathodes or anodes for high voltages.—*December 8th*, 1927.

281,978. August 30th, 1927.—IMPROVEMENTS IN OR RELATING TO ELECTRIC CURRENT RECTIFIERS, Etablissements de Man, Société Anonyme, of 26, Longue Allée, Antwerp, Belgium.

The object of this invention is to provide a current rectifier for converting alternating current into direct pulsating current suitable for use in radiology and adapted to feed X-ray tubes with a much higher efficiency than is obtainable with a mechanical rectifier. In the drawing, A and B are two portions of the secondary winding of a transformer, the primary winding C of which is connected to a supply of alternating current. An electronic valve D is connected in series with the secondary winding A B, and this valve, together with the adjacent portion B of the winding, is shunted by a con-



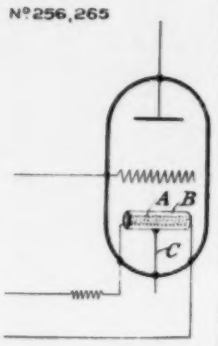
denser E, connected to a point F and to the terminal G. The other terminal H is situated at the free end of the portion A of the secondary winding. The external circuit K comprising, for example, an X-ray tube, is connected to the terminals H and G. Supposing the point F is in the middle of the winding A B, a positive wave passing through the transformer will cause the winding B to charge the condenser E through the valve D, and will set up at G a potential x. This potential will be maintained while the negative wave passes, the valve preventing the condenser from discharging. Meanwhile, the winding A will cause the potential at H to oscillate between x and $-x$, so that the maximum tension in the circuit K is $x-(-x)=2x$, which is the full tension supplied by the transformer, while the minimum tension is $x-x=0$. By varying the position of

point F along the secondary winding of the transformer the degree of asymmetry of the rectified current can be varied at will.—*December 15th*, 1927.

TELEGRAPHS AND TELEPHONES.

256,265. July 31st, 1926.—THERMIONIC TUBE, Dr. Siegmund Loewe, of 108, Gitschinerstrasse, Berlin, S.W. 61.

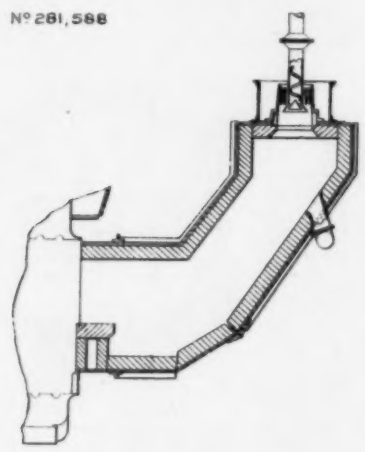
This invention relates to the thermionic valves of the kind in which a cathode having an equi-potential surface is adapted to be heated by an auxiliary heating element which may be connected directly to continuous or alternating-current mains. The leading in wires are connected to an incandescent filament A, consisting, for instance, of nickel resistance wire. A thin tube B of quartz or mica is disposed around the incandescent filament A, the tube being brought to red incandescence through the heat developed by the filament. The outer surface of the tube B is made somewhat conductive by means of a coating of platinum, which is obtained, for instance, by cathode dispersion. The tube is connected with the wire C. The surface of the tube, which is covered with a coating of platinum or another metal, is also covered by metal oxides having highly emissive qualities. The grid and the anode may surround the tube B. If the incandescent filament A is surrounded by an insulating material, such as, for instance, mica, or if the incandescent filament is rigidly wound upon a quartz tube, so that it will be of sufficient mechanical strength, the tube B may consist of metal, which is coated with metal oxides. The advantage of this arrangement is that by reason of the large surface of the tube A the space charging surface will be exceedingly small. There will be no voltage drop along the surface of the tube B, so that the electrons will not pass in a direction which is partly parallel to the surface, such as is the case with incandescent cathodes of the ordinary kind. The electrons will be emitted from the surface of the tube in a very uniform manner, and in a direction which is perpendicular to the surface.—*November 30th*, 1927.



FURNACES.

281,588. May 26th, 1926.—POWDERED FUEL FURNACES, J. J. C. Brand, Australia House, Strand, London, W.C. 2, and B. Laing, 100 Victoria-street Westminster.

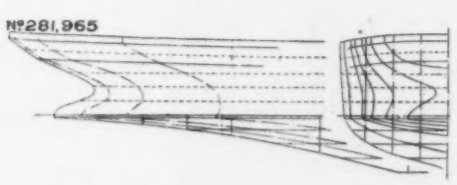
This invention comprises "a method of or apparatus for combusting powdered fuel in existing marine locomotive or other types of boiler furnaces wherein the combustion space is relatively small. It consists in providing a separate combustion chamber of suitable size composed of or lined with refractory material and arranged in front of and externally of the usual furnace space, the said combustion chamber being provided with an inclined front wall and with one or more burners or injectors at its upper part through which powdered fuel and primary air are projected downwardly into the combustion chamber."—*November 28th*, 1927.



SHIPS AND BOATS.

281,965. June 30th, 1927.—SHIP'S FORM, Deutsche Werke Kiel Aktiengesellschaft, and G. Wahl, 114, Werftstrasse, Kiel, Germany.

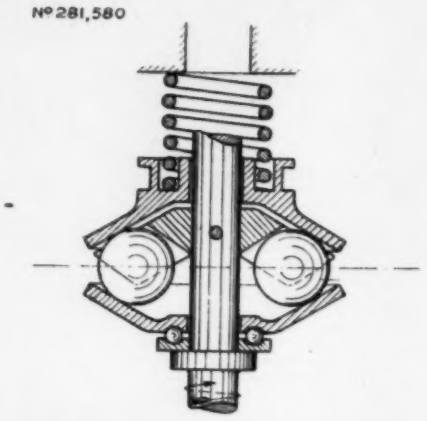
This invention relates to ordinary sea-going vessels in which the construction and lines forward of the stern are in accordance with usual practice and consists essentially in that the stern of the ship in the region of the normal load line is widened out and the timbers of submerged hull portion are applied with a sharp knuckle, the keel rising gradually to the normal load line. It is claimed that by this form of the ship's stern a substantial reduction of the ship's resistance is attained. With the ordinary stern the water behind the ship is stirred up and a stern wave is thereby formed, necessitating the expenditure of power which is lost for the forward movement of the ship. This waste of energy is obviated by the improved ship's form, since here the water is held together under the stern so that no stern wave is formed. The formation of a stern wave is further prevented by the sharp knuckle at the normal load line on which the streamlines break off.—*December 15th*, 1927.



MISCELLANEOUS.

281,580. August 15th, 1927.—CENTRIFUGAL GOVERNORS, H. Junkers, 21, Kaiserplatz, Dessau, Anhalt, Germany.

In this centrifugal governor the weights take the form of balls, which are free except that they are embraced by a cage keyed to the driving shaft in such a manner that they must rotate with the shaft, but can move radially. They are also confined between two conical discs, one of which is fixed axially and is supported by a ball thrust bearing, while the other is restrained by a spring and actuates the mechanism to be governed. The operation of the governor needs no comment.—*December 8th*, 1927.



Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

INSTITUTION OF ELECTRICAL ENGINEERS: NORTH-EASTERN STUDENTS' SECTION.—Armstrong College, Newcastle-upon-Tyne. Paper, "Remote Control Systems," by Mr. D. E. Lambert. 7.15 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster, London, S.W. 1. Fifth Report of the Steam Nozzles Research Committee. 6 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Paper, "Steam Accumulators," by Mr. S. Hopkins. 7.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. Discourse, "Photo-electricity," by Sir William Bragg. 9 p.m.

ROYAL SOCIETY OF ARTS: INDIAN SECTION.—John-street, Adelphi, London, W.C. 2. "The Indo-European Telegraph Department," by Mr. M. G. Simpson. 4.30 p.m.

SATURDAY, JANUARY 21ST.

INSTITUTION OF AUTOMOBILE ENGINEERS.—London Graduates' visit to the works of C. A. Vandervell and Co., Ltd., Acton, W. 3. 2.30 p.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Town Hall, Devizes, Wilts. Southern District meeting. 12 noon.

MONDAY, JANUARY 23RD.

BRADFORD ENGINEERING SOCIETY.—Technical College, Bradford. Lecture, "Modern Boiler Setting," by Mr. G. Murray. 7.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: NORTH-EASTERN CENTRE.—Armstrong College, Newcastle-upon-Tyne. Paper, "Large Electrical Baking Ovens," by Mr. W. Ellerd-Styles. 7 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster, London, S.W. 1. Graduates' meeting. "Cutting Steel and Iron with Oxygen," by Mr. C. G. Bainbridge. 6.30 p.m.

INSTITUTION OF WELDING ENGINEERS.—Caxton Hall, Westminster, London, S.W. 1. Paper, "Electric Welding Repairs to Inflated Gasholders," by Mr. A. E. Plumstead. 7.30 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. Cantor Lecture, "The Scientific Foundations of the Refining of Petroleum," by Dr. A. E. Dunstan. 8 p.m.

TUESDAY, JANUARY 24TH.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, Westminster, London, S.W. 1. Paper, "Railway and Vehicular Bridge Across Vancouver Harbour, B.C. (Canada)," by Mr. A. D. Swan. 6 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: NORTH MIDLAND CENTRE.—Albert Hall, Cookridge-street, Leeds. Faraday Lecture, "Electricity in the Service of Man," by Dr. S. Z. de Ferranti. 7.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. "Dielectrics for Electrical Condensers," by Mr. P. R. Coursey. 5.15 p.m.

SOCIETY OF TECHNICAL ENGINEERS: BIRMINGHAM BRANCH.—Queen's Hotel, Birmingham. "Scientific Management," by Professor J. F. Rees. 7.45 p.m.

WEDNESDAY, JANUARY 25TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Birmingham Graduates' visit to the works of the Daimler Company, Ltd., Coventry. 2.45 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Friary Hotel, Derby. Derby Graduates' annual dinner. 7.15 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: NORTH OF ENGLAND CENTRE.—The Engineers' Club, Manchester. Paper; "Design and its Effect on Maintenance Charges," by Mr. F. H. Paul. 7 p.m.

INSTITUTION OF CIVIL ENGINEERS: MANCHESTER AND DISTRICT ASSOCIATION.—Literary and Philosophical Society's Rooms, 36, George-street, Manchester. Vernon Harcourt Lecture, "Appliances for Handling Goods in Ports and Docks," by Mr. H. A. Reed. 6.45 p.m.

THURSDAY, JANUARY 26TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Royal Hotel, Mill-street, Luton. Luton Graduates' meeting. Paper, "The Automobile from the User's Point of View," by Mr. B. V. Woolcock. 7.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. "Unsaturation of Carbon Compounds," by Professor J. F. Thorpe. 5.15 p.m.

FRIDAY, JANUARY 27TH.

CHEMICAL ENGINEERING GROUP.—Dyers' Hall, Dowgate-hill, London, E.C. 4. Joint meeting with the Society of Dyers and Colourists. "Dry Cleaning and Finishing Machinery," by Mr. A. J. Hatfield. 6.45 p.m.

INDUSTRIAL WELFARE SOCIETY.—Hotel Metropole, Northumberland-avenue, London, W.C. 2. Conference on Accident Prevention. 11 a.m.

INSTITUTE OF METALS: SHEFFIELD LOCAL SECTION.—Mappin Hall of the University, St. George's-square, Sheffield. "The Metal Aeroplane," by Mr. J. C. Buchanan. 7.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster, London, S.W. 1. Informal meeting. Discussion on "Applications of Electro-chemical Deposits of Metals to Engineering Purposes," introduced by Mr. C. H. Faris. 7 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Paper, "Powdered Fuel for Boiler Firing," by Mr. R. H. Allen. 7.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Mining Institute, Newcastle-upon-Tyne. Paper, "Ship Vibration Periods," by Mr. J. Lockwood Taylor. 6 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. Discourse, "Prehistoric Cave Art," by Miss D. A. E. Garrod. 9 p.m.

SATURDAY, JANUARY 28TH.

INSTITUTION OF CIVIL ENGINEERS.—Students' visit to the works of the Westinghouse Brake and Saxby Signal Company, Ltd., York-road, King's Cross, N. 1.

CONTRACTS.

WILLIAM BEARDMORE AND CO., Ltd., have received from the Crown Agents for the Colonies an order for 4144 tons of steel rails and 120 tons of fish-plates, of which the approximate value is £35,000. These rails are for the Kenya and Uganda Railways.

THE "DE MAAS" SHIPBUILDING COMPANY, of Slikkerveer, Holland, has received from the Dutch Ministry of Public Works an order for the construction of two lock-gates for the North Sea Canal, Holland, and also an order for the construction of a mooring pontoon with bridges for the Flushing Harbour Works.

THE RITCHIE-ATLAS ENGINEERING COMPANY, of Atlas Works, Temple, Glasgow, W. 2, has received an order from the Glasgow Corporation for the design, manufacture and erection of telpher extension, ash hopper, and coke handling and screening plant to the value of £15,000. This is in addition to a similar contract for coke-handling plant for Dawsholme Gasworks received a few weeks ago.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

MR. A. H. BARKER, M. Inst. C.E., of 100, Victoria-street, Westminster, has been appointed consulting engineer for the million-pound rebuilding scheme of the University of Leeds, for which Messrs. Lanchester, Lucas and Lodge are the architects.

THE PREMAG PNEUMATIC ENGINEERING COMPANY, Ltd., asks us to announce that it has moved its offices from 59–61, Hatton-garden, to 120, Cheapside, London, E.C. 2, and its stores to Center Engineering Works, Belvedere Buildings, Southwark-Bridge-road, S.E. 1. Telephone, Hop 5616.

DIAMOND COAL CUTTER COMPANY, Ltd., of Stennard Works, Wakefield, asks us to announce that its name has been changed to British Jeffrey Diamond, Ltd., and that the change was brought into effect as from January 2nd, 1928. The business of the company will be continued as heretofore.

AUTOMATIC AND ELECTRIC FURNACES, Ltd., of Holloway, London, N. 7, asks us to announce that an agreement has been entered into between Automatic and Electric Furnaces, Ltd., London, and the Allgemeine Elektricitats Gesellschaft, Berlin, whereby the latter company will now manufacture and sell Wild-Barfield electric furnaces in Germany, Austria-Hungary, Jugo-Slavia, Bulgaria, Turkey, Greece, Roumania, China, Finland and Luxemburg. This agreement will not in any way affect the British company's manufacturing and selling arrangements.

HAMS HALL POWER STATION.—We are desired by Alfred Herbert, Ltd., to say that the pulverised coal equipment for the Hams Hall Power Station will be composed of Atritor unit pulverisers manufactured by them, as they hold a sub-contract from International Combustion, Ltd. There will be twenty-five large pulverisers.

RAILWAYS IN 1927: ERRATUM.—A rather unusual error, which can hardly have escaped the attention of our readers, occurred in the first paragraph of the article entitled "Railways in 1927," on page 37 of our last issue. It is the use of the word "millions" in place of "thousands" for the expenditure of the railway companies on new works.

THE Papers Committee of the Institution of Electrical Engineers desires us to say that the Progress Reviews which appear from time to time in the *Journal* of the Institution are obtainable from the secretary in pamphlet form at the price of 1s. per copy. The following three reviews appear in the January issue of the *Journal* just published:—"Electricity in Mines," by J. A. B. Horsley; "Co-operative Research in 1927," by E. B. Wedmore; "Electrical Standardisation, 1927," by P. Good.

WOOD-WORKING AND OTHER MACHINE TOOLS FOR NEW ZEALAND.—In addition to the orders for railway workshop material which it was announced a short time ago the New Zealand Government was placing in this country, the High Commissioner, Sir James Parr, has now received intimation that another £50,000 of wood-working machinery and various types of machine tools are required. Tender forms for this material are now being circulated amongst manufacturers in Great Britain, the closing date being May 25th at Wellington. The High Commissioner can supply full particulars, specifications and drawings to all British manufacturers in a position to tender for any of this equipment.